AVIATION
AND
AERONAUTICAL ENGINEERING

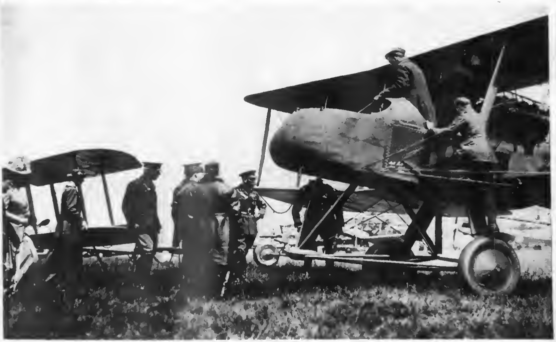

Photo by Central News Photo Service

King George and Queen Mary Visit an Aerodrome

OCTOBER 15th 1916

SPECIAL FEATURES

PUBLISHED SEMI-MONTHLY
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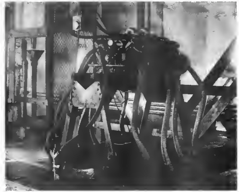
THE GARDNER, MOFFAT CO., Inc.
120 W. 32nd ST. NEW YORK



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Glenn L. Martin Company

Los Angeles, Cal.

OCTOBER 15, 1916

AVIATION AND AERONAUTICAL ENGINEERING

VOL. I. NO. 6

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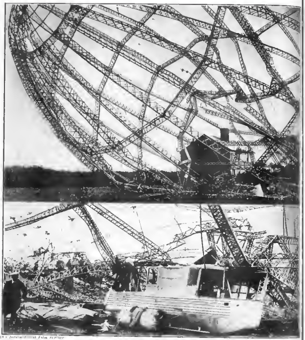
THE GARDNER, MOFFAT COMPANY, Inc., *Publishers*
120 WEST 32D STREET NEW YORK

SUBSCRIPTION PRICE, ONE DOLLAR PER YEAR. SINGLE COPIES TEN CENTS. CANADA AND FOREIGN: ONE DOLLAR AND A HALF A YEAR.

ISSUED ON THE FIRST AND FIFTEENTH OF EACH MONTH. FORMS CLOSE FIVE DAYS PREVIOUSLY. ENTERED AS SECOND-CLASS MATTER, AUGUST 3, 1916, AT THE POST OFFICE AT NEW YORK, N. Y., UNDER ACT OF MARCH 3, 1879.



(C) International Film Service

Two views of a Zeppelin [illegible] down on British soil. The enormous size of the structure is clearly shown, as well as the intricate [illegible] iron construction. The lower view shows one of the cars.

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Vol. I October 15, 1916 No. 6

TWO announcements made by the Aviation Section of the Signal Corps of the Army in the last few days will go far toward convincing the public that solid progress is being made to create a substantial military air service. Eight pursuit scout machines have been ordered, four of the Curtiss triplane type and four Sturtevant biplanes. These speedy scouts are, if unofficial accounts are true, practically equal to foreign aircraft of the best military pursuit types.

Their uses in time of war were clearly explained in the memorandum issued by the War Department, and published exclusively in AVIATION AND AERONAUTICAL ENGINEERING on September 15. By ordering these new types almost immediately after their initial tests the Aviation Section has shown that it is prepared to make good its assurance that it will not hesitate to purchase, to promote development, the types it is convinced will be required for active military duty. Another significant fact about this order is that a triplane has been accepted. As will be seen from the picture elsewhere in this issue, it is a radical development in aeroplane design and its acceptance by the War Department gives splendid proof of a willingness to assist aeronautical engineers in developing new ideas in construction.

In this issue will be found the tentative plans for the permanent organization of the Aviation Section, the requirements for service in the Officers Reserve Corps, the requirements for the Enlisted Reserve Corps, the regulations for Civilian Aviation Schools and the method to be followed for application by National Guardsmen.

The great importance of this announcement will be evident to all who have been confused by the misleading reports that have been widely circulated. It will settle at once all questions regarding the qualifications, service, remuneration and procedure for the personnel of our reserve air service. It is to be hoped that many of the aviators whose names were published in our last issue will report as requested for enlistment. It would be an object lesson to the country if some of the American fliers whose names are internationally famous would offer their services for the reserve corps.

To those who have been led to believe that every aviator could become an officer by the simple expedient of taking a few months training at an army aviation school the plans will be disillusioning. An officer in the United States Army has always represented intellect as well as fighting ability. The officers of the Aerial Reserve Corps will be required to come up to the standard set for all other reserve officers. For this reason the requirements call for "the equivalent of a college education." There should be no misunderstanding of this phrase. It is a qualification that is used to apply to all reserve officers. It is used as a qualification for admission to any of the camps such as the Plattsburg training camp and simply means that to be accepted a man must have at least as much experience of the world as is afforded by a college education. No one ought to be deterred from making application for the Officers Reserve Corps because he has not been to college.

By the ordering of the pursuit machines and announcing the tentative Reserve plans the Aviation Section has taken a great forward step toward solving both the matériel and personnel problems. The public, disturbed by irresponsible reports, will find in these progressive steps cause for genuine confidence in the ability and efficiency of the Aviation Section.

Suggestions for Aeronautical Motors

This issue of AVIATION AND AERONAUTICAL ENGINEERING contains some quotations from the minutes of the public meeting of the Executive Committee of the National Advisory Committee for Aeronautics. This meeting was called in order to signalize the new order of affairs in Washington in which cooperation shall be the keynote of the government's dealings with aeronautical constructors. The meeting was called to give the government officials a chance to say definitely and concisely what they want and to give the manufacturers a chance to explain the difficulties and problems which they have met in dealings with the government hitherto.

The chief difficulties with motors complained of by the Army and Navy officers were of four kinds, the first really comprising all the others. The officials complained (1) of lack of reliability, (2) of faulty magneto mounting, (3) of defective electric wiring, (4) of inability to get deliveries of the sort of motors they want.

Nearly every manufacturer represented complained of the lack of stimulus, the lack of orders. This fault can easily be overcome now that Congress has appropriated more than \$16,000,000 for Army and Navy aeronautics. The niggardly appropriations of past years have damaged and held up the industry to an extent which it would be almost impossible to estimate.

The magneto mounting problem and the electric wiring problem ought not to be difficult of solution.

The object of printing these extracts in tabulated form is a sincere endeavor to make all the information brought out at the session available to aeroplane buyers and constructors alike.

Tentative System for the Organization of the Aviation Section

(Official Announcement by the Officer in Charge, Aviation Section, Signal Corps, U. S. A.)

Aside from the officers and enlisted men of the Regular Army, the aviation personnel may consist of civilians employed by the Aviation Section of the Signal Corps, reserve officers, enlisted men of the Enlisted Reserve Corps, and National Guard organizations mustered into the service of the United States.

As far as flying is concerned, nearly all the personnel must be trained from unconstructed material. This also applies, to a great extent, to mechanicians and chauffeurs.

In general, the central office must provide for three divisions of duty.

First.—The provision of adequate material, such as aeroplanes and their accessories. This involves the preparation of specification for the material and its inspection under the inspection department of this office. The inspection department in future is intended not only to reach all manufacturing plants and producers of material, but also all materials in the hands of tactical units.

Second.—A system by which the personnel will be trained. This involves a school system for the officers and a training system for the men in both civilian and military institutions.

Third.—The establishment of tactical units, their administration and supply.

The first will be handled by the central office through its technical departments, and issues of supplies ordered when and where necessary.

The second will be decentralized, as far as possible, but should be under the general jurisdiction of the central office in the same manner as other military educational institutions and service schools are under the War Department. There will be two general categories of schools: (a) The United States Army Aviation Schools (such as the one now at San Diego, Cal.), whose number, for the time being at least, is intended to be 3, that is, 1 for the Pacific coast, 1 for the Central States, and 1 for the East, (b) civilian schools maintained by manufacturers or others, which may be utilized for preliminary training purposes.

The country will be divided into three school districts. The commanding officer of the school at San Diego will have general jurisdiction over all the schools in the Western Department, the commanding officer of the school in the central part of the country will have jurisdiction over all the schools in the Central and Southern Departments, and the commanding officer of the school in the East will have jurisdiction over all the schools in the Eastern Department.

It is intended (eventually) to send aviation personnel for all formations, except those of the Regular Army, to civilian aviation schools to obtain their preliminary instruction, after which they may finish their course at the Army aviation schools and obtain their military aviators' ratings.

The civilian schools will be handled along the following lines:

(a) A type of training machine will be prescribed by the Government for the use of the schools, (b) the schools will be given a certain compensation for the instruction of such personnel as may be assigned to them—this reimbursement will include the average breakage and will be paid when the student satisfactorily completes the course; students before assignment to a civilian school will be subjected to an examination by a board to determine their physical, mental, and moral qualifications to take the course.

Having completed their instruction, the students will be available for commissions as reserve officers and assignment to units or other duty.

MILITARY DEPARTMENTS

Each department will have an aviation officer, to be designated as such, on the staff of the department commander. The aviation officer, under the department commander, will have general supervision over all aviation personnel and stores (with the exception of aviation schools, testing grounds and general supply depots of aviation material) within such departments, the general control of all officers, men and civilian employees of the aviation section within the department, the instruction and equipment of all tactical units of heavier-than-air and lighter-than-air craft, the preparation of requisitions for the proper supply of aero units in his department, the plans for the creation of new aero units within the department, both in the Regular Army and the reserve of the Regular Army, and all other matters affecting the aviation section, including lists of the personnel of the Aviation Section, Signal Officers' Reserve Corps and the Enlisted Reserve Corps, Aviation Section, Signal Corps.

When this system is fully put into effect, the aviation officers of the various departments will remain the same in peace and war and the organization will be capable of rapid expansion to take care of war conditions. The tactical units (an aero squadron hereafter will have a depot unit of 9 officers and 20 men) would move off into the field, leaving behind them their respective depots, which depots could be moved wherever necessary, and personnel supplied directly to them from the school and depot systems.

The above indicates merely a general plan to be followed, as it is not deemed expedient to specify minute details to too great an extent at present. To begin with, the system will be put into effect by the issuance of orders and directive letters to the various officers concerned. Later, when all the points have been tried out, these matters may be incorporated into Army regulations.

Personnel will be obtained for the Aviation Section, Signal Corps, United States Army, as now prescribed by law and Army regulations.

Personnel for the Aviation Section, Signal Officers' Reserve Corps, under section 37, national defense act, will be obtained as prescribed in General Orders, No. 32, War Department, July 28, 1916, and as per appendix A, herewith.

Personnel for the Enlisted Reserve Corps, Aviation Section, Signal Corps, under section 55, national defense act, will be obtained as prescribed in appendix B, herewith.

Requirements for civilian aviation schools as contained in appendix C, herewith.

The method by which officers and men of the National Guard may be detailed for duty at aviation schools under section 99, national defense act, is mentioned in appendix D, herewith.

Appendix A

REQUIREMENTS FOR SERVICE IN THE AVIATION SECTION, SIGNAL OFFICERS' RESERVE CORPS

1. Authority has been issued by the Secretary of War for the organization of the Aviation Section, Signal Officers' Reserve Corps. The section may consist of 296 officers. The grades in said section shall be in the same proportion as those obtaining in the Aviation Section of the Signal Corps, United States Army, up to include the grade of major. Unless specially authorized by the officer in charge of the aviation section all successful applicants for commissions in the Aviation Section, Signal Officers' Reserve Corps, will be commissioned in the grade of second lieutenant.

2. Any male citizen of the United States not under 21 nor over 30 years of age, desiring a commission in the Aviation Section, Signal Officers' Reserve Corps, will submit a letter in the following form to The Adjutant General, United States Army, to the adjutant of the department in which he resides, or to the officer in charge of the Aviation Section, Signal Corps of the Army.

Letter of Application for Examination for Commission in Officers' Reserve Corps

(Under section 37, act of June 3, 1916.)

The ...., 19....

Sir: I have the honor to apply for examination for a commission as [1] .... of [2] .... in the Officers' Reserve Corps organized under the authority of Congress.

I have served .... years in [3] ....

I have pursued a regular course of instruction for .... years in [4] ....

I graduated in the year .... from [5] .... after having creditably pursued the course of military instruction therein provided. [6]

I was born .... and am [7] .... a citizen of the United States. My business is ....

My experience is .... I enclose letters of recommendation and addresses of citizens who know me as follows: ....

Respectfully,

The correctness of the statements above made was sworn to and subscribed before me, ..., 19....

[1] Insert grade.
[2] Insert branch of service, staff corps or department, as Cavalry, Field Artillery, Coast Artillery, Infantry, Quartermaster Corps, etc.
[3] Name staff position, and in this case rule out 1 and 2.
[4] Insert service in Regular Army of the United States, or Volunteer forces of the United States, or Organized Militia of any State, Territory or District of Columbia, also state in what capacity.
[5] Insert name and location of school or college.
[6] Insert the name and location of the educational institution in which an officer of the Army or Navy has been detailed as superintendent or professor pursuant to law.
[7] Insert "not" if in accordance with fact.
[8] Oath to be taken before and signature to be made by officer authorized by law to administer oaths.

NOTE.—The foregoing is the form to be followed in applying for examination and is to be addressed to the adjutant of the department in which the applicant lives, The Adjutant General of the Army, or the head of the staff corps or department concerned.

The communication authorizing the examination of the applicant will be sufficient authority when submitted to the president of the examining board before which the applicant will be ordered to appear. This board will consist of from two to five commissioned officers of the Regular Army of the United States, or of regular and reserve officers of the Signal Corps, including at least one and not more than two medical officers; at least one officer of the Regular Army will serve on each board. This board will be appointed on the recommendation of the officer in charge of the Aviation Section of the Signal Corps of the Army.

Each applicant will be subjected to the same physical examination as is required of officers of the Regular Army applying for aviation duty. Applicants will not be examined mentally but the equivalent of a college education will be required. The examining board will consider documentary evidence submitted by the applicant. It may seek additional information by practical tests, personal questions, or by procuring additional documentary evidence. Flying ability will be given first consideration, noted and reported in the proceedings of the board. No applicant for a commission as an officer of the Aviation Section, Signal Officers' Reserve Corps, will be considered proficient until he is able to pass the flying test for Reserve military aviator, unless specially excepted for reasons stated by the officer in charge of the Aviation Section, Signal Corps of the Army.

After the required examination the proceedings of the board will be forwarded to the headquarters of the convening authority with the recommendations of the board as to the qualifications of the applicant. The officer in charge of the Aviation Section, Signal Corps of the Army, shall recommend to The Adjutant General the grade in which each candidate should be commissioned. After appointment by the President, The Adjutant General will issue the commission. The commissions of the officers of the Officers' Reserve Corps will be in force for a period of five years, unless sooner terminated at the discretion of the President. Such officers may be recommissioned either in the same or higher grades for successive periods of five years, subject to such examination as may be prescribed.

In time of actual or threatened hostilities officers of the Officers' Reserve Corps are subject to such duty as the President may prescribe. Heads of staff corps when authorized by the Secretary of War, may order reserve officers to duty for periods not to exceed 15 days a year, and while so serving such officers will receive the pay and allowances of their respective grades in the Regular Army.

With the consent of the reserve officers concerned and within the limit of funds available for the purpose, officers of the Officers' Reserve Corps will be retained on active duty for such periods as the Secretary of War may prescribe.

In order to qualify for examination as officers of the Aviation Section, Signal Officers' Reserve Corps, especially qualified citizens of the United States not under 21 nor over 27 years of age will be assisted by the United States as follows: To become eligible for obtaining such instruction, the person desiring it shall make application to the officer in charge of the Aviation Section, Signal Corps, who, if the applicant is considered desirable, will cause such applicant to be examined by the same board convened for the examination of officers of the Aviation Section, Signal Officers' Reserve Corps, which board will pass on the applicants' physical, mental and moral qualifications. The physical test shall be the same as that required for officers of the Aviation Section of the Signal Corps. In the mental test the applicant will be required to establish the fact that he has the equivalent of a college education. The moral test will require the applicant to establish his reliability and good habits. The candidate will be required to state in writing that if he successfully passes his aviation tests he will become an officer in the Aviation Section, Signal Officers' Reserve Corps. If the candidate successfully passes the board will so recommend to the officer in charge of the Aviation Section, Signal Corps. The officer in charge of the Aviation Section, Signal Corps, will then designate the applicant as an aviation student. If the student desires to enlist in the Aviation Section of the Enlisted Reserve Corps, he will be made a non-commissioned officer and placed on active duty up to the time his course is finished and he is discharged to accept a commission in the Aviation Section, Signal Officers' Reserve Corps. If he fails in his course, he may apply for his discharge from the Aviation Section of the Enlisted Reserve Corps. If the student does not desire to enlist he may attend the course as a civilian at his own expense. The aviation student will then be assigned by the officer in charge of the Aviation Section to a school for his instruction. Such school may be either a United States aviation school or a civilian aviation school. The civilian aviation school will be one approved by the officer in charge of the Aviation Section, Signal Corps, as to instructors, machines used and character of instruction given. The manufacturers' schools shall receive $500 for each aviation student who qualifies for the preliminary flying test, the test to be conducted by an officer or agent of the Aviation Section of the Signal Corps. For any aviation student who qualifies as a reserve military aviator upon graduation from a civilian aviation school an additional $300 will be paid to such school. Upon the candidate satisfactorily passing the reserve military aviator's test he will receive a commission as an officer in the Aviation Section, Signal Officers' Reserve Corps, without further examination.

It is the intention gradually to organize reserve aero squadrons in various parts of the country from the commissioned and enlisted reserve personnel.

Appendix B

REQUIREMENTS FOR SERVICE IN THE ENLISTED RESERVE CORPS, AVIATION SECTION, SIGNAL CORPS

Qualifications

1. *General requirements.*—Service in the Enlisted Reserve Corps, Aviation Section, Signal Corps, is by enlistment. Applicants must not be under 18 nor over 45 years of age. They must be of good antecedents and habits and free from bodily defects and diseases. They must be citizens of the United States or have made legal declaration of their intention to become citizens of the United States and be able to speak, read, and write the English language. Before enlisting, they are required to pass physical examination to determine their fitness for service in the United States Army. Before authority for enlistment is granted the applicants will furnish two or more certificates of good moral character. As the service is technical men qualified as aviators, balloonists or mechanicians, who have had experience in the construction and repair of aeroplanes or internal-combustion engines are particularly desirable.

2. Following are the numbers authorized in each grade:

(1) 54 master signal electricians.
(2) 190 sergeants, first-class.
(3) 271 sergeants.
(4) 543 corporals.
(5) 1,381 privates, first-class.
(6) 278 privates.

2,715 total.

3. Qualifications for enlistment direct into each of these grades are as follows:

(1) Candidate must have a working knowledge of gasoline motors, magnetos, carburetors, telegraphy, and a fair knowledge of the principles of electricity and photography.

(2) Working knowledge of motors, magnetos, and carburetors.

(3) and (4) A general knowledge of subjects given under (1) and (2) and have sufficient training and interest to show that he is adaptable to work of this kind.

(5) Applicant must show an interest in the subjects mentioned, be competent, and keen to insure that he will develop along the proper lines in training.

When men enlist in any of the above grades, certificates of enlistment in the Enlisted Aviation Reserve Corps will be issued by the Adjutant General of the Army. These certificates shall confer upon the holders when called into active service or for purposes of instruction and training, during the period of such instruction and training, all the authority, rights, and privileges of like grades of the Regular Army. Members of the Enlisted Reserve Corps, Aviation Section, Signal Corps, shall take precedence in said grade according to dates of their certificates of enlistment therein, and when called into active service, or when called out for purposes of instruction and training, shall take precedence next below all other enlisted men of like grades in the Regular Army. The President is authorized by law to assign members of the Enlisted Reserve Corps, Aviation Section, Signal Corps, as reserves to particular organizations of the Regular Army. The

Secretary of War is authorized by law to order enlisted men of the Enlisted Reserve Corps, Aviation Section, Signal Corps, to active service for purposes of instruction or training for periods not to exceed 15 days per year, provided that with the consent of such enlisted men and within the limits of funds available for such purposes such periods of active service may be extended for such number of enlisted men as may be deemed necessary. Enlisted men will receive the pay and allowances of their respective grades in the Regular Army, but only when ordered into active service, including the time required for actual travel from their homes to the places to which ordered and return to their homes.

4. *Rates of pay.*—The grades and pay of the enlisted force of the Aviation Section, Signal Corps, United States Army, are as follows:

	While serving in the U. S., Hawaii, Porto Rico or the Canal Zone *Per month*	While serving in Alaska, China or the Philippines *Per month*
Master signal electricians	$75.00	$90.00
Sergeants, first-class	45.00	54.00
Sergeants	36.00	43.20
Cooks	30.00	36.00
Corporals	24.00	28.80
Privates, first-class	18.00	21.60
Privates	15.00	18.00

In addition to the above there will be a slight increase per month after each enlistment period of four years. All enlisted men, in addition to their regular pay, receive rations, quarters, clothing, fuel, bedding, medicine and medical attendance when required.

When called into active service of the United States members of the Enlisted Aviation Reserve Corps will receive the rate of pay corresponding to their grade.

5. *Retirement.*—Enlisted men of the Aviation Reserve Corps will not be entitled to retirement or to retired pay, nor shall they be entitled to pension except in case of physical disability incurred while in active service or while traveling under orders of competent authority to or from designated places of duty.

6. *Uniform.*—The uniform to be worn by the enlisted men of the Enlisted Reserve Corps, Aviation Section, Signal Corps, except corps insignia, shall be the same as prescribed for enlisted men of the Aviation Section, Signal Corps of the Regular Army Reserve. In time of peace there shall be issued to each enlisted man of the Enlisted Reserve Corps, Aviation Section, Signal Corps, such articles of clothing and equipment as may be prescribed. All clothing and equipment shall remain the property of the United States.

7. *Term of enlistment.*—The term of enlistment is four years.

Appendix C

REQUIREMENTS FOR CIVILIAN AVIATION SCHOOLS

(An inspection will be made by an officer of the Aviation Section of the Signal Corps to determine whether the requirements are fulfilled.)

1. *Field.*—The field should be of sufficient size and shape to permit of landing and getting away in at least two different directions under normal conditions. The ground must be fairly level and free from obstructions of all kinds. These requisites will be determined on inspection by an officer or agent of the Aviation Section of the Signal Corps.

2. *Training machines.*—The training machines will comply with the specifications prescribed by the Aviation Section for the preliminary and advanced training types. These specifications will be furnished all civilian schools who instruct students for the Government or desire to do so.

3. *Instructors.*—Instructors must be men of experience in flying and thoroughly competent to teach through the reserve military aviator stage. They should be level-headed, have good judgment and sufficient mental balance to impart what they know.

4. *Character of instruction.*—The course of instruction will be divided into two stages. The first stage will include instruction and qualification through and to include the preliminary flying test. This test will be held under the supervision of an officer or agent of the Aviation Section of the Signal Corps. The second stage, which is optional with the school authorities, will consist of advanced training necessary to qualify an aviation student as a reserve military aviator. An advanced training type of machine will be used at least during the last stages of this instruction. Detailed information as to the course to be followed in this stage will be furnished the school authorities. The reserve military aviator test will be held under the supervision of an officer or agent of the Aviation Section of the Signal Corps.

5. *Preliminary flying test.*—(a) Three sets of figure eights around pylons 1400 feet apart. In making turns around pylons all parts of machine will be kept within a circle whose radius is 800 feet.

(b) Stop motor at a minimum height of 300 feet and land causing machine to come to rest within 150 feet of a previously designated point.

(c) An altitude test consisting of rising to a minimum height of 1000 feet.

(d) Glides with motor throttled, changing direction 90 degrees to right and left.

NOTE.—(a) and (b) may be executed in one flight. (c) and (d) in one flight. The same rules apply in starting from and landing on water. Special attention will be paid to the character of landings made.

Should any aviation student desire to take the pilot license test prescribed by the Aero Club of America, every facility will be offered for him to do so.

Report of these tests will be submitted to the officer in charge of the Aviation Section, with the information as to whether or not the school will complete training of the aviator through the reserve military aviator stage.

6. *Reserve military aviator test* will be as follows:

(a) Climb out of a field 2000 feet square and attain 500 feet altitude, keeping all parts of machine inside of square during climb.

(b) Glides at normal angle with motor throttled. Spirals to right and left. Change of direction in gliding.

(c) At 1000 feet cut off motor and land within 200 feet of a previously designated point.

(d) Land over an assumed obstacle 10 feet high and come to rest within 1500 feet from same.

(e) Cross-country triangular flight of 30 miles passing over two previously designated points. Minimum altitude 2500 feet.

(f) Straightaway cross-country flight of 30 miles. Landing to be made at designated destination. Both outward and return flight at minimum altitude of 2500 feet.

(g) Fly for 45 minutes at an altitude of 4000 feet.

7. *Pay for tuition.*—Upon the student passing the preliminary flying test satisfactorily the school will be paid $300. If the student is continued under instruction until he satisfactorily passes the reserve military aviator test an additional $300 will be paid the school.

8. All candidates for the Aviation Section, Signal Officers Reserve Corps, will be required to pass the prescribed physical examination, must weigh not more than 190 pounds stripped, must furnish evidence of having a college education and be of good moral character.

9. Applicants for commission as a reserve officer who hold the pilot certificate from the Aero Club of America will after successfully undergoing the prescribed physical examination be given a flying examination embodying at least the requirements of the preliminary flying test. If competent, he may also take the reserve military aviator's test.

If the preliminary flying test is passed satisfactorily and the candidate qualifies in other respects, he will be eligible for further instruction to qualify as a reserve military aviator.

If in addition to the preliminary flying test the candidate also passes the reserve military aviator's test satisfactorily he will be given a commission in the Aviation Section, Signal Reserve Corps, provided all other qualifications are fulfilled.

Appendix D

DETAIL OF OFFICERS AND ENLISTED MEN OF THE NATIONAL GUARD AT SIGNAL CORPS AVIATION SCHOOLS

Officers and enlisted men of the National Guard may be detailed at Signal Corps aviation schools under section 99 of the national defense act. National Guard officers and men desiring such course will put in their applications to the adjutant general of their respective States who will forward the applications direct to the Chief, Militia Bureau, War Department, Washington, D. C. Such officers and enlisted men will be required to pass the prescribed physical and mental examinations which will be similar to those required of reserve officers, Aviation Section, Signal Officers Reserve Corps. On approval by the Militia Bureau orders will be requested from the Adjutant General of the Army assigning such officers or enlisted men to duty at aviation schools.

Franklin Institute Lectures on Aeronautics

The Franklin Institute of the State of Pennsylvania, in its programme of lectures for 1916-17, includes two lectures which will be of paramount interest to engineers and designers of aeroplanes and aeroplane motors and to fliers.

On March 1, 1917, Henry Souther, consulting engineer of the Aviation Section of the Signal Corps, U. S. A., will speak upon "Development and Progress in Aviation Motors" and on March 15, J. C. Hunsaker, U. S. N., will deliver a lecture with the subject "Design, Construction and Equipment of a Modern Military Aeroplane."

The Development of the Zeppelin Airship*

By Count von Zeppelin

Count von Zeppelin's attention to the possibilities of airship construction was first drawn by a speech of the Secretary of the Post Office Department, Mr. Stephan, in the year 1874. The little airships of small capacity which existed at that time, such as the French military balloon "La France," could not be taken as models. The Austrian airship constructed by the Engineer Schwarz, was unknown when the first planes were completed. But this much was clear, that the first practical airship would have to be of very large dimensions.

The small buoyancy of the air, one kilogram (approximately) per cubic meter, as compared with one thousand kilograms per cubic meter of water, at once laid the burden of very large dimensions, and the combination of extreme light-

FIG. 1. THE FIRST ZEPPELIN Z 1

ness of weight with extraordinary strength on airship construction. This raised many doubts as to the possibilities of such construction.

To remove such doubts, it was necessary for the first ship to raise its own weight, the fuel for several hours' flight, ballast water, different apparatus, lines and anchor gear, and in addition to attain a speed of at least 9 meters per second with the necessary crew on board. In order to further safeguard against accident, an additional buoyancy was figured on for greater strength and as a precaution against failure of any part of the construction. These requirements were equivalent to a gas volume of 11,300 cubic meters.

The covering of the frame, the outer skin, consisted of a layer of waterproofed cotton, and an inner layer of silk, the latter being used to obtain a light construction. As there was at that time no means of making this gold-beaters' skin sufficiently pliant, gummed cotton was used, which Dutlenhofer and Lawentaal had applied to their balloons to make them gas tight.

It was difficult to determine whether to build of wood, aluminum or steel. After considerable research work, aluminum was decided upon as the building material, proving, however, to be inappreciably lighter than wood, particularly in view of the limited knowledge of its application in those days. Steel was not considered, since for the required strength the edges would be too thin to hold and would tear out when secured, while the use of thicker bars would result in too great an increase in weight.

As a source of power to drive the ship, the Daimler motor, the most reliable and relatively light motor at that time, was chosen. It weighed 30 kilograms per horsepower and required 500 grams of benzine per horsepower-hour. A 9-horsepower motor then required as much as 200 liters of cooling water for a 10-hour run. In order to avoid heavy and long gearing, and to keep the diameter of the ship reasonably small, the four bladed propellers, with a diameter of 1.15 meters, were selected, which, in spite of the necessarily hasty construction, yielded an efficiency of 71.3 per cent.

Once the volumetric contents of the airship was decided upon, the shape was determined from the practical relations between the smallest surface area to obtain the smallest weight of hull, and the shape giving the least resistance.

Having regard for the handling of the ship on the ground and the size of the building ship, it was necessary to use a diameter of only 11.6 meters, which finally led to a length of eleven times this diameter, or 128 meters. It appeared impossible to build this extremely long form rigid by means of the inner pressure alone, and so the rigid type of construction was evolved.

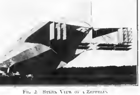


FIG. 2. STERN VIEW OF A ZEPPELIN

But even with this construction the weights could not be concentrated under the center because the longer the supporting girders are the stronger they must be, and thus a limiting length is arrived at where the weight of the construction is greater than the gain in lifting force due to the increased contents volume. For that reason the weights of the machinery and driving gear and the cabins were divided in two parts and hung one under the center of buoyancy of the forward part and one under center of buoyancy of the after half of the ship.

The calculations and preliminary considerations for the elements of construction were completed, and the first complete airship was finished at the end of the year 1900. It had the following dimensions:

Diameter	11.6 meters
Length	128.0 meters
Largest cross section area	106 square meters
Contents	11,300 cubic meters

Both pointed ends similar and each 16 meters long.

The cross-sectional form was a polygon of 24 sides, built as an open framework, consisting of longitudinals and transverse frames. The intervals between transverse walls was 8 and 4 meters, the whole space for the gas being divided into 17 compartments. The aluminum which served as the material of construction had a specific weight of 2.7 and a tensile strength of rupture of 33 kilograms per square meter. The frames proper were built of angle and T bars and the bracing girders of angle bars. The weight of these frames as applied to the construction was 0.9 and 1.8 kilogram per meter length, the weight of the entire frame being 5,825 kilograms. This was equivalent to 0.516 kilogram per cubic meter of volume.

Corresponding to the number of compartments, there were 17 gas cells of gummed cotton, the portion on the upper half of the ship weighing 0.17 kilogram per square meter, while that on the under body, being less heavily gummed, weighed 0.15 kilogram per square meter. The outer skin had a weight of 0.13 kilogram per square meter on top and 0.083 kilogram on the under side, and therefore a mean weight of 0.107 kilogram per square meter.

*Abstract by W. P. Bechler of an Article in the 1915 Annual of the Society of Naval Architects, Berlin. This abstract will be followed by one of a more technical character by Count Von Zeppelin's Engineer.

The side steering was accomplished by means of a box framework containing steering planes at each end, the steering in altitude was first by deep hanging weights, later by running weights. At the third ascension, however, an elevating rudder was placed at the forward end, and the safe handling of the ship under all conditions was thereby made doubly certain. Between the first and second as well as between the third and fourth sections along the length of the ship, were hung rigidly

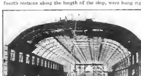


FIG. 1 STEEL WORK OF THE ZEPPELIN SHED IN FRIEDRICHSHAFEN

secured pontoons, each containing a 14.7 horsepower Daimler motor. By means of double bevel pinions of cast aluminum and bevel shafting and rawhide, each motor drove two right and two left turning propellers which were situated at the height of the center of resistance. The machinery installation had a combined weight of 1,970 kilograms, or 67 kilograms per horsepower.

This first airship, with all its faults, furnished a good basis for the development of the rigid system, but greater lifting capacity had at once to be obtained. No lighter gas could be used, and a decrease in the weight of the material of construction was also impossible. On the contrary, the weight of the gas cells was found to be continually increasing so that it was raised from 170 grams per square meter to 230 grams per square meter, until the proper method of handling the

FIG. 4. DOOR OF THE ZEPPELIN SHED

goldbeaters' skin was discovered, when the weight was again reduced to 170 grams per square meter. The impermeability was practically an accomplished fact. The weight of the outer skin was also raised, as in the first ship the silk used on the under cover was found to be too weak and liable to stretch, and had to be replaced by cotton.

To increase the carrying capacity, therefore, there remained mainly the possibility of increasing the size of the gas space within the limits of proper handling on landing and the size of the building ship, and a more economical use of aluminum. The introduction of spacious triangular girders in the place of the flat girders, as well as a more efficient application of pressed and stamped forms, resulted in a considerable saving in the weight of material used.

The greatest benefit gain from the increased lifting capacity which was brought by these means, was the possibility of a further increase in speed, by the employment of larger motors. Progress in the direction of greater speed was also due to the production of more reliable and lighter motors. The increased carrying capacity also gave the possibility of using a third motor for wireless apparatus, living spaces, ladders leading to the platform on the upper part of the body of the ship, etc.

A comparison between the "Sachsen" and the first "Zeppelin" built shows the improvements that have been accomplished in the design in the intervening fourteen years. The diameter has increased from 11.0 to 14.8 meters, the length

FIG. 5 THE FIRST ZEPPELIN OF 1900 AND THE "SACHSEN" OF 1914

from 128 to 149 meters, wherein the length is only ten times the diameter as opposed to eleven times the diameter in the original ship, the contents from 11,300 cubic meters to 20,800 cubic meters, an increase of 9,500 cubic meters, which means an increase in initial lifting force of from 9,000 to 11,000 kilograms.

The 24-sided polygon has been changed to 17 sides, and the former blunt nose has been lengthened to 28 meters, while the after point is now 32 meters long. The "Sachsen" has 17 compartments. The style of construction and material have remained the same. While increase in strength has been obtained by the newer frame girders having a mean saving in weight of 0.13 kilogram per meter of length, yet the fact which stands out most is, that in spite of the relatively smaller bending moment obtaining with the first ship there was a sagging or distortion of the frame of about 25 centimeters, while in the latest ships there is no appreciable change in shape, even under varying conditions of service.

The first ship developed so many small faults—such as the sticking of the rudders and the failure of the valves, etc., that

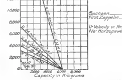


FIG. 6. CAPACITY OF EARLY AND LATE TYPES AT VARIOUS POWERS

a speed greater than 9 meters per second could not be obtained and it could only carry fuel for about a ten hour trip.

Fig. 5 shows the remarkable increase in power of present airship over the first small ship. The "Sachsen" with a speed of 72 kilometers per hour, a crew weighing 1,900 kilograms, and an available carrying capacity of 3,000 kilograms, makes a round trip of 2,200 kilometers; and against a head wind, that would have held the first ship in its place, and is still able to make a trip of 1,480 kilometers. The more economical the ship is with the fuel, or in other words the slower it travels, the greater will be the distance traveled. At half speed the length of trip will increase to 2,900 kilometers, with a crew weighing 1,000 kilograms, and an available capacity of 3,900 kilograms.

The Curtiss 250-Horsepower 12-Cylinder Motor

The Curtiss Aeroplane Company announces that it has recently built, and is offering for sale to speed-boat owners and aviators, a twelve cylinder 7" x 7" motor, which was designed for aeronautical uses primarily. This engine is rated at 250 horsepower but it is claimed to develop 300 at 1400 revolutions per minute.

The accompanying views give a clear idea of the compactness of this motor, the extreme over-all length being 80 inches. The characteristic feature, seen in the view from bottom of crankcase (Fig. 1), is the very large, counter-balanced crankshaft, having a bearing between each crank. The crank pins are of 2½ inches diameter and the main journals of 2¾ inches diameter. The bearing caps not only show eight bolts to each one, but are steel keyed into the crankcase to prevent any lateral movement. Also individual forced lubrication enters through the bottom of each cap where the load is greatest on the bearings. A large annular thrust and radial ball-bearing

FIG. 1

are contained in the housing shown at the left end of the illustration.

In the view looking down upon the motor (Fig. 2) can be seen the two separate twelve-cylinder Dixie magnetos furnishing double ignition, with the consequent reduction of the chances of mis-firing. Two Duplex Zenith carbureters are used. The compactness of this motor, developing as it does 300 horsepower, is well shown here.

The view shows up a generous sump holding oil for eight hours' normal running, and also indicates method of mounting this engine. The seven steel tubes giving this support are passed clear through the crankcase, and, therefore, receive all the strain of the mounting. The little white pull-handle, seen just over the right-hand magneto, is one of two which open the exhaust valves about ⅛ of an inch to relieve compression while cranking. This also permits gasoline to enter the cylinders when priming through a hole in each exhaust pipe.

By pulling out one of these handles, the motor can be cranked with no more effort than is required with a six-cylinder engine of the same bore and stroke or an ordinary powerful automobile motor. Installation of self-starters is readily possible with this type engine.

GENERAL DESCRIPTION OF CURTISS MODEL V-4

Type of Motor—12-cylinder water-cooled V-type, separate cylinders.

Horsepower—Rated 250 horsepower.

Motor Speed—1,400 revolutions per minute normal, 1,500 revolutions per minute maximum, 200 revolutions per minute minimum.

Bore and Stroke—5 x 7 inches.

Weights—Motor, 1,125 pounds; radiator, 120 pounds; cooling water 100 pounds, propeller, 95 pounds.

Gasoline Consumption per Horsepower Hour—6/10 pounds.

Oil Consumption per Hour at Maximum Speed—2 pints.

Installation Dimensions—Overall length, 84⅝ inches; overall width 34⅛ inches; overall depth, 40 inches, width at bed, 30½ inches; height from bed, 21⅛ inches, depth from bed, 18½ inches.

Equipment—Magneto, carburetor, exhaust, manifold, radiator propeller, tachometer complete, self-starter, tools, shipping box.

DETAILS OF MOTOR

Ignition—2 high tension 12-cylinder magnetos, located on front of crankcase cover and driven off timing gears through new wear-saving flexible drive. Leather boot on magnetos. Rubber covers on spark plugs.

Carburetors—4 "Zenith." Each intake supplies one set of 3 cylinders through separate cast aluminum manifolds. Hot air intakes to carburetor through stoves around exhaust pipes. Auxiliary air intake in manifolds with hand control. Carburetor located between cylinders inside V.

Lubrication—Pressure feed. The oil is forced from reservoir in bottom of crankcase by gear pump to one end of hollow camshaft through camshaft to timing gears and all camshaft bearings and is carried to main bearings by separate pipe and through crankshaft throws to connecting rod bearings and from connecting rod through tubes on connecting-rods to piston pins. Return oil is pumped out of the splash-pan into reservoir so lubrication is not affected by the inclining of the motor.

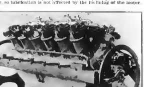


FIG. 2

Water Circulation—Centrifugal pump bolted to front end of crankcase cover and driven through spiral gears mounted on ball-bearing shaft.

Cylinders—Made of high carbon steel drop-forging machined all over. Monel metal side wall brazed on. Outside of cylinder heavily nickel-plated to prevent rust. Cylinders bolted to crankcase by 12 bolts.

Valves—Poppet type in head. Intake nickel steel. Exhaust Tungsten steel.

Valve Springs—Coil type intake, offset type exhaust.

Valve Cages—Valves seat direct in cylinder head.

Rocker Arms—Drop forgings case-hardened and nickel-plated.

Cam Followers—Plunger type open-hearth steel, case-hardened.

Cam Follower Guides—Manganese bronze. Bolted to case by two studs.

Camshaft—Open-hearth steel drilled hollow, cams integral, 7 bearings, cams case-hardened. Bearings and cams ground.

Camshaft Bearings—Aluminum alloy castings. Split type bolted together and held in crankcase by locked set screw.

Pistons—Aluminum alloy die castings. Two cast-iron eccentric rings.

Piston Pins—Nickel steel heat treated. Drilled hollow, case-hardened and ground. Pin bearings direct on aluminum of piston bosses. Pins pressed in connecting rods and held by locked set screw.

Connecting Rods—Of the forked type made from chrome vanadium steel forgings machined all over. Eye-beam machined out from the solid.

Connecting Rod Bearings—Fabrig white metal, bronze backed. Reamed to running clearance of exact size of crank shaft. Bearing held in fork rod and rotating in single end rod.

Crankshaft—Heat treated chrome vanadium forging finished all over and drilled hollow. Six throw, seven main bearings. All bearings ground. End of shaft splined, tapered and threaded for propeller hub. Size of shaft 2½ inches on crank-pins, 2¾ on main bearings.

Crankshaft Bearings—Fabrig white metal bronze backed. Reamed to exact size of crankshaft. Caps aluminum. All caps held on with 4 large bolts.

Propeller Bearings—Large annular and thrust ball-bearing mounted in extended end of crankcase.

Crankcase—Aluminum alloy casting. Seven motor support tubes, lower half bolted on.

Timing Gears—Helical teeth type Crankshaft gear steel forging pressed in and keyed to shaft Half time gear special manganese bronze keyed on camshaft and held with retaining nut locked to gear

Magneto Drive—Steel bevel gear driven off separate shaft on gear case cover, mounted on ball bearings Flexible coupling between magneto shaft and drive shaft

Water Pump—Centrifugal type Cast aluminum housing and impellor

Tachometer Drive—Shaft gearing in aluminum housing bolted on face of timing gear housing and driven in conjunction with pressure air pump through universal drive direct off half time gearing

Exhaust Pipe—Steel tubes bolted to exhaust ports.

Water Piping—Brass tubing nickel plated. Rubber hose connections with special clamps. All cylinder nipples and connections brazed and nickel plated.

Radiator—Special honeycomb type sufficient for cooling under all conditions.

Propeller—Standard Curtiss

Bolts, Nuts Etc—All nuts are cotter pinned and nickel plated

Outline of Course of Instruction for the Training of Aviators

By Lawrence B Sperry

Much has been said and written in the last two years on the training of aviators, and we of this country are vitally interested in the subject, since the recent appropriations have assured the formation of a sizable air service. An investigation into the present civilian aviation schools reveals the fact that the men are turned out knowing only the rudiments of flying and without being instructed in the finer points that are essential in the making of a capable aviator Unnecessary risks are taken by pupils in many of the schools, which could easily be avoided if the proper instructions were given.

The following outline of instruction is one that the writer, who has made a study of the matter in the principal aerodromes of Europe since the beginning of the war, considers would render training in flying not only safe to the pupil, but calculated to make him an experienced pilot ready for military work

First Stage The preliminary part of the course may be divided into three parts.

1 The student pilot should take a few trips as a passenger to accustom himself to air travel and height, as well as to the ordinary maneuvers of the machine

2 He should fly a dual controlled machine under the guidance of the instructor, in order to learn the control movements. This machine should be equipped with some means of inter-communication so that the pilot may instantly direct the pupil. He should be taught how to get off the ground by running along the ground until flying speed is attained before elevating This point is important for two reasons.

(a) The aeroplane will get off the ground at a lower speed than that at which it will retain buoyancy, because of the "ground bank" This "ground bank" consists of a blanket of air, close to the surface of the earth, of greater density when the machine is passing over it than that encountered at a hundred feet elevation. A machine traveling at a speed capable of sustaining flight a few feet from the ground will go into a stall when it rises out of this "bank"

(b) If the machine is elevated from the ground before it obtains full flying speed, the energy of the motor is expended in lifting the machine, instead of going into speed as it does when the machine is allowed to run on the ground a sufficient length of time It must be remembered that the quickest climb for getting over trees and the like is obtained by allowing the machine full acceleration on the ground

3. The pupil should then be taught to maintain a straight course, to make proper turns, and to land properly This instruction in landing is most important, and the following points should be brought out

(a) The wheels of the landing chassis and the tail skid should strike the ground simultaneously

(b) There is a speed at which the maximum lift angle is able only to sustain the plane, this is the critical speed at which the controls should be brought quickly in toward the chest of the pupil in order to increase the angle beyond the maximum lift angle, thereby increasing the resistance of the wings and throwing the greater part of this resistance into drift, which slows the machine down to a minimum.

(c) Such landing is desirable not only because of the reduced speed, which is advantageous when one is landing on rough ground, but also because the tail, on account of being low, throws the center of gravity far back in relation to the wheels, thereby reducing the possibility of the machine nosing over. This is also very advantageous as a means of protecting the propeller, especially on tractors with small propeller clearance

(d) The pupil should have at least six hours' training in a dual controlled machine, this time being divided into lessons of not more than fifteen minutes' duration

Second Stage The pupil should fly alone at a large field in a penguin, i e, a machine the wing spread of which is so reduced that it is capable of flying not more than five feet from the ground This teaches the pupil not only the art of getting the most results from small horsepower, which is of great advantage in case of motor disability in a large machine, but it also teaches him principally what it means to get into a stall near the ground

Third Stage The pupil should be allowed to fly alone under ideal air conditions, in a higher powered machine in a large field, at least one-half mile wide by one mile long having been previously instructed simply to make straightaways up and down the field and turning the machine around at each end on the ground

Fourth Stage. The pupil should be instructed to climb to an altitude of at least 600 feet, and then to make a very slow turn and land in the opposite direction This is watched by an instructor through a pair of binoculars, to enable him to observe the pupil carefully and to advise him of his mistakes after his return. At the same time that the air instructor is directing the student's field work, the pupil is learning practical theory, with the aid of a blackboard, about subjects such as tail spins and their recovery, spirals, the prevention of stalling, the making of a landing in a small field against the wind without the necessity of spiraling, by zig-zagging back and forth against the wind, etc. This instruction is incorporated in a complete course of aerodynamics, aeroplane design and construction

The pupil is now ready for spirals, which should be made at an altitude of not less than 3000 feet and finished at an altitude of not less than 1100 feet The pupil should not make continuous spirals, but should turn first 90 degrees to the right and 90 degrees to the left with the motor shut off, then 180 degrees to the right and 180 degrees to the left, after that 360 degrees each way, gradually working up to three spirals to the right and three to the left, always finishing with an altitude of 1100 feet.

Fifth Stage Part of the field, if the field is large, is marked off one-quarter mile by one-quarter mile The pupil is instructed to fly off the field with the wind in different directions, and on the sounding of a gun to shut his motor instantly and to make the field safely without turning more than 90 degrees In case he finds that he is not within gliding distance of the field, he should be instructed to plug in his motor again and to continue his flight, rather than to take any chances in landing

Sixth Stage Landing on a mark is practiced

Seventh Stage Each of the requirements of the Junior Military License is practiced, except the cross country flights, which are withheld until the course of training is completed

Eighth Stage The pupil flies at 5000 feet and deliberately stalls in the air four times, each time at a steeper angle than the one before, until a tail slide is made These stalls are to be made with the use of an angle of incidence indicator, the pupil carefully watching the indicator and slowly placing his machine at the stalling angle

Ninth Stage The pupil is instructed to loop at an altitude

of not less than 5000 feet, after which he should stall the machine at the same time throwing his rudder hard over one way, thus putting his machine into a tail spin if the machine is capable of executing this maneuver To recover from the tail spin is the salient point that the pupil is now to learn This is effected by throwing his rudder over in the opposite direction, which requires a tremendous pressure on the rudder bar The writer has found it necessary to exert the force of both feet The pupil is now ready to take his military license

It might be well to remember at this point that looping, tail sliding, and such alleged stunting, is only carried on with definite objects in view, namely—

1 To give the pilot confidence

2 To teach him quick recoveries from unsafe positions, especially near the ground should he find himself in such positions in the course of carrying out his work as a military aviator

Tenth Stage After the pupil has secured his military license instruction in night flying should be given This is both one of the most difficult feats of military aviation and one of the most important, a great deal of time and attention being given to its development by all of the warring European nations Night flying should be taught in four stages as follows

1 The pupil should fly as a passenger with a competent pilot, thoroughly familiar with night flying

2 The pupil should fly alone on a moonlight night, or one in which the stars are bright enough to give considerable light.

3. The pupil should begin flying before sundown on a cloudy day, and should continue flying until the sun sets, not landing until total darkness has fallen No night flying should be undertaken in a machine not equipped with a night flying outfit

4. The pupil should practice night flying, using his night flying equipment to signal the aerodrome when he intends landing In case of war, the aerodromes are unlighted except for a single beam of light, which is thrown vertically machines also are not illuminated, but, on desiring to land, their pilots flash on their night flying equipments signaling by prearranged code to the aerodrome, whereupon the grounds are illuminated for landing

The pupil should be cautioned against inadvertently getting into fog There are foggy days when, although it is not possible to see more than 600 feet straight ahead, it is frequently practicable to fly These days can be gauged by looking straight upward at the sky If the azure blue can be seen, the fog is limited to a blanket that does not extend over 500 or 600 feet above the ground While the pupil is climbing in this fog, he can see nothing but fog surrounding him. When he has climbed just above the fog, he can see beneath it, and as he climbs higher and higher, he begins to be able to see around him. This is due to the fact that it is only possible for him to see through the blanket of fog at an obtuse angle when a large area of the ground becomes visible from an elevation of some 2000 feet

Flying in fog is very similar to night flying, as it requires a fairly developed sense of equilibrium In both night flying and flying in fog it is extremely advantageous to use a machine equipped with an automatic pilot

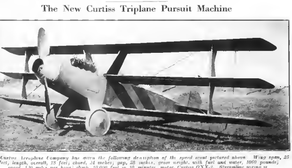
During the latter part of the tenth stage, the pupil should be allowed to carry an observer as passenger, so as to familiarize himself with the various maneuvers that are necessary in order that he may obtain such information as he requires. This needs a system of cooperation, and some means of communication between the pilot and observer.

Coming into a small field against the wind, the pilot pupil should either zig-zag or reduce his altitude to 200 or 300 feet in going abeam or at right angles to the wind This prevents him from getting into the predicament of going short of his mark

It should be remembered that in learning to turn, if the pupil attempts to make his turns sharp or short at first, no matter how much he practices, he will never learn how to accomplish a perfect turn The only way he can expect to learn to turn satisfactorily is first to make the turns very big watching all the time his revolutions, and his air drift indicator, and also his angle of incidence indicator, if he has one, being sure all the time to keep his relations at all parts of the turn exactly right Otherwise, if he tries to do short turns he will think he is doing correctly when he is really on the brink of dangerous positions.

The pupil should be watched continually through glasses and made to repeat any faulty maneuver until he does it perfectly Any tendency toward over-confidence and carelessness in landing should be followed by a suspension of three days in one week

The New Curtiss Triplane Pursuit Machine



The Curtiss Aeroplane Company has given the following description of the speed scout pictured above Wing span, 25 feet, length, overall, 18 feet, chord, 24 inches, gap, 28 inches, gross weight, with fuel and water, 1060 pounds, speed, 120 miles per hour, climb, 10 000 feet in 10 minutes, motor, Curtiss OXX-2. Streamline wiring is used throughout and shock absorbers are streamlined. The War Department has ordered four

Course in Aerodynamics and Aeroplane Design*

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PART I—SECTION 6

Effects of Variations in Profile and Plan Form of Wing Sections

As we have seen in Section 5, numberless variations are possible in the profile of wing sections. A slight variation in the profile may, however, introduce considerable changes in the aerodynamic properties of a wing, and necessitate a wind tunnel test. Experiments conducted at the various laboratories on variations of camber, of position of maximum ordinate, on the thickening of leading and trailing edges, and so forth, have therefore rather a qualitative than a quantitative significance. But the results obtained deserve attention, and may serve as a guide to useful modifications. The most important of these experiments are summarized here, and a fuller reference list is appended.

Effect of Variation of Position of Maximum Ordinate in a Wing Section of Plane Lower Surface, and Constant Camber 0.100 for Upper Surface

These experiments of the N. P. L. are mainly interesting because they indicate where approximately the maximum ordinate of a section should be to give the best possible L/D ratio.

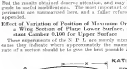


Fig. 1. Sections Used in Investigating Variations of Position of Maximum Ordinate

In Fig. 1 are shown a selection of three of the sections tested. They were all developed from one section by altering the position of the maximum ordinate and compressing or expanding the other ordinates to correspond. The Lift and Lift/Drag curves for these sections show considerable variations in values as can be seen from the following table:

TABLE 1.

Wing Sections Plane Lower Surface. Upper Surface Camber 0.100. Position of Maximum Ordinate Varied.

Section	Ratio of position of maximum ordinate to chord length.	Maximum L/D	Angle for maximum L/D	Maximum K_y in lbs., sq. ft., miles/hour units.	Angle for maximum K_y
A	.500	11.2	8°	.00317	18
B	.332	13.6	4°	.00258	16
C	.168	11.0	4°	.00206	8.8

We see that the maximum L/D for section B with a ratio .332 is as high as 13.6, while for section C, where the maximum ordinate is well forward, it sinks to 11. Again, the maximum lift for B is about 50 per cent. greater than that for C. The angle of maximum lift also appears much earlier when the maximum ordinate is nearer the leading edge. A further inspection of the N. P. L. curves also shows that at the point of maximum lift, a slight variation in the ratio changes a smooth burble point into a dangerously steep one.

The main result of the investigation is to show the care required in altering even slightly the position of maximum ordinate for a given section, and also to indicate that the best position is about one third from the leading edge.

Behavior of Wings with Reverse Curvature at the Trailing Edge

This constitutes a far more important question than that of the preceding paragraph. It would considerably simplify aeroplane design, from the point of view of statical and dynamical stability if the position of the centre of pressure or of the vector of resultant force on the wing did not vary its position so rapidly with change in the angle of incidence. It may be said that as a general rule for the usual angles of flight that when the angle of incidence decreases the centre of pressure on a wing moves far back, and the resultant force tends to dive the machine, decreasing the angle of incidence still further. When the angle of incidence increases, the centre of pressure moves forward and the resultant force tends to stall the machine, increasing the angle of incidence still further. We shall deal fully with this important point when considering the general statical equilibrium of the aeroplane.

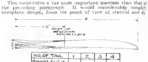


Fig. 2. Modifications of the R. A. F. 6 with Upturned Trailing Edges

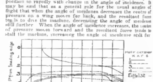


Fig. 3. Travel of Center of Pressure for a Series of Wings with Upturned Trailing Edges

Among other means of attaining stability, wings have been designed with a slight reverse curvature at the trailing edge, which have been very successful in keeping the centre of pressure motion within narrow limits. It is important to us to see what sacrifice of sustaining power and efficiency reverse curvature entails.

At the N. P. L. a section (No. 1) very similar to that of the R. A. F. 6 was employed, and three reversed curvature forms 2, 3, 4 were developed from it by turning up the trailing edges through successively increasing distances while keeping the thickness of section unaltered. The point of inflexion, at which the reflexing began was in each case 0.4 of the chord from the trailing edge, though this could be varied to 0.2 without much effect. These sections are illustrated in Fig. 2.

The travel of the centre of pressure is shown in Fig. 3 for all five sections. The curves for the N. P. L. sections show that as the elevation of the trailing edge increases, the centre of pressure motion becomes less marked in its movement toward the trailing edge, becomes stationary, and finally moves toward the leading edge. This is certainly satisfactory from the stability point of view, but the questions of efficiency and maximum lift have also to be considered. The following are the values obtained for maximum L/D and maximum K_y.

*This Course commenced in the August 1, 1916 issue of Aviation and Aeronautical Engineering, will be completed in 24 issues. It will embody the fundamental aeronautical data necessary for aeroplane design, and present the design of standard machines in complete simple and systematic form.

TABLE 2

Section	Amount lift is raised as fraction of chord	Maximum L/D	Maximum K_y
1	0.000	15.7	.00320
2	0.011	15.8	.00294
3	0.027	14.1	.00262
4	0.057	11.0	.00248

It can be seen that as the rear edge is turned up the L/D and the maximum K_y both decrease progressively.

The main conclusion of the British investigators was that with an elevation at the rear edge of about .037 of the chord, the centre of pressure can be kept stationary, but with a loss of 12 per cent. of the maximum L/D and 25 per cent. loss of the maximum possible lift. This would be too great a sacrifice for the sake of stability and the designer would find other methods of stabilization such as the use of dihedral in biplanes and negative stabilizers far more useful.

Eiffel has, however, investigated a section with a very slightly reversed trailing edge (Eiffel No. 32 Lanier-Lawrance, details of which have been given in Section 5), which is a far more satisfactory and in wide use. Its maximum L/D is about 18.2, minimum lift coefficient is about .0033, and it has an excellent working range. The centre of pressure motion is almost null between 0 degrees and 10 degrees of incidence, and such a wing would certainly not tend to dive a machine, although it is not very good at stalling angles. Its shape offers certain constructional difficulties in the region of the rear spar.

Effect of Thickening the Leading Edge of a Wing

Contrary to a somewhat common conception, the thickening of the leading edge as shown in Fig. 4 was distinctly disadvantageous, the decrease in efficiency progressing proportionately to the thickening.

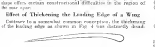


Fig. 4. Sections Employed in Investigating Effects of Thickening Leading Edges

Effects of Thickening Wing Towards the Trailing Edge

Thickening towards the trailing edge is sometimes advantageous from the point of view of structural strength, and experiments have been conducted to see the loss in aerodynamic efficiency such thickening involved. The sections employed are shown in Fig. 5. It appears from these experiments that the lift coefficient at a given angle of incidence is not much affected at angles greater than 7 degrees but that at smaller angles of incidence the lift coefficient is actually a little greater for the thickened sections. The maximum Lift/Drag steadily diminishes as the trailing edge is thickened:

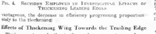


Fig. 5. Experiment of Thickening the Trailing Edge of Wing

TABLE 3

Section.	Maximum L/D
1	17.2
2	15.8
3	14.2
4	14.0

"Phillips Entry"

As shown in Fig. 6, the section R. A. F. 4 was modified into the R. A. F. 5 to give the well-known "Phillips Entry." This modification was found to have no effect on the aerodynamic properties of the wing, an important consideration in view of the fact that numerous attempts have been made to utilize this modification.

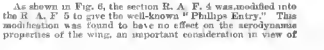


Fig. 6. Modification of R. A. F. 4 Wing to Give Phillips Entry

Effects of Varying Aspect Ratio

Foppl's and Eiffel's experiments have dealt with cambered plates, the N. P. L. has investigated the effect of varying aspect ratios on a practical wing section rectangular in plan similar to the Bleriot XI bis which is shown in Fig. 7. For a more or less accurate understanding of the phenomena accompanying such variation, it is necessary to consider pressure distribution, but for design it is more important to bear in mind the simple results of this investigation:

Fig. 7. Wing Section Employed at the N. P. L. in Investigation of Effects of Varying Aspect Ratio

As aspect ratio increases

(1) The maximum L/D ratio improves, the corresponding angle of incidence remaining sensibly the same, and the L/D at other angles improves also
(2) the drag diminishes
(3) the lift coefficients at all except very small angles and the maximum lift coefficient remain practically constant, the maximum lift coefficient occurs at a smaller angle of incidence.
(4) the angle of no lift occurs at smaller positive angles, or larger negative angles as the case may be.

Although the Bleriot wing tested by the N. P. L. was of practical form, it is not commonly employed in modern construction. The correction tables (Tables 4 and 5) are solely based on results derived from it, and it does not at all follow that similar corrections would apply to wings of other form. In default of other experimental work, however, such corrections can be applied with probably a fair degree of accuracy. The values for aspect ratio of 6 are taken as a standard of comparison, thus being the aspect ratio used for so much experimental work on wing sections.

TABLE 4

Approximate Corrections for Maximum L/D with Variation of Aspect Ratio

Aspect ratio.	Ratio of maximum L/D to maximum L/D at aspect ratio 6
3	.77
4	.83
5	.92
6	1.00
7	1.08
8	1.11

The following table shows the ratio of drag to drag for aspect ratio 6 as unity:

TABLE 5.

Approximate Correction for Values of K_x with Variation of Aspect Ratio

Angle of incidence	Aspect Ratio 3	4	5	6	7	8
0	1.12	1.06	1.00	1	1.10	1.00
2	1.16	1.06	1.02	1	1.00	1.09
4	1.13	1.022	1.10	1	1.00	1.00
6	1.11	1.021	1.03	1	.91	1.14
8	1.22	1.040	1.01	1	.89	.81
10	1.04	1.047	1.00	1	.88	.81
12	1.00	1.056	1.11	1	.98	.86
14	1.14	1.071	1.02	1	.92	.89
16	1.17	.94	1.00	1	.85	1.01
18	.970	1.130	.91	1	1.00	1.20

Choice of Aspect Ratio

In selecting ratio for an aeroplane many other considerations enter besides those of aerodynamic efficiency. Thus as aspect ratio and the span of the wings increase, the heavier the structure becomes for the same strength. This involves heavier bracing and more structural head resistance, the increase in weight itself reduces the aerodynamic efficiency indirectly. Hence if the aspect ratio were increased to an exaggerated extent, structural difficulties would more than counterbalance the gain due to this increase. The question is too complex for theoretical treatment or for definite rules. Later in the design of a standard machine, comparative designs will be made for various values of aspect ratio.

For preliminary design, the best method of fixing aspect ratio is to follow standard practice, and this would indicate:

5 to 1 aspect ratio for monoplanes and small biplanes.

6 to 1 or 7 to 1 for large biplanes.

Effects of Raking the Plan Form of a Wing

Experiments on the effect of raking the plan form of a wing have been conducted by Eiffel in France and Foppl in Germany, references to which are given at the end of this section.

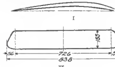


FIG 8. SECTIONS EMPLOYED IN EIFFEL'S EXPERIMENTS ON "RAKING"

Unfortunately, their investigations were mostly on circular wings, were somewhat contradictory and results varied with different cambers.

In the experiment which Eiffel conducted on a practical wing section, Coanda Wing, Eiffel No. 38 as illustrated in Fig. 8, the raked wing was decidedly superior to the rectangular form into which it was cut down. Nor can this improvement be due to variation in aspect ratio which is negligibly small. The ratio of maximum L/D was about 1.2 to 1.

It would seem therefore that experiment is in agreement with practice in imputing certain advantages to raking. But in view of the variation in results with wings of different camber, it would be unsafe to employ a correction ratio of 1.2 in maximum L/D for the raking of any other wing, say an R. A. F. 6 section, until there has been further investigation of this point.

Swept Back Wings

Another variation in the plan form of wing sections, very largely employed on German machines of recent type, and also on one or two American machines, is that of swept back wings. Swept back wings are mainly used to give lateral stability. It has also been thought that their arrow-like form gave them an increased aerodynamic efficiency, and that longitudinal stability was also improved by their employment. We are not at present concerned with lateral stability. Aerodynamically a recent investigation at the Massachusetts Institute of Technology shows a progressive decrease in efficiency with increased sweep back. As regards longitudinal stability the action is peculiar and not at all as satisfactory as that of the wings with reversed trailing edges.

An R. A. F. 6 wing, originally of aspect ratio 6 was employed and swept back as shown in Fig. 9. The results of the investigation are summarized in Table 6.

TABLE 6.

Section	Sweep back	Angle of incidence for maximum L/D	Maximum L/D	K_y for maximum L/D	Angle of incidence for max K_y	Maximum K_y
1	0	4°	17	.00143	14°	.00281
2	10	4°	16.5	.00130	16°	.00274
3	20	4°	16.2	.00128	16°	.00274
4	30	4°	12.5	.00128	17°	.00258

Up to 20 degrees sweepback, it can be seen that the loss in efficiency is not so great, but the 30 degree entails a loss for which good lateral stability would scarcely compensate.

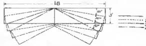


FIG. 9. WINGS USED IN EXPERIMENTS ON SWEPT BACK WINGS

The centre of pressure motion is illustrated in Fig. 10. It has the same peculiar characteristic for each of the wings. At small angles the centre of pressure moves forward, thus checking diving, but at large angles the centre of pressure again moves forward, thus tending to stall the machine. Longitudinal stability is thus only partially secured.

Negative Wings Tips of Swept Back Wings, Their Effect on Longitudinal Stability

Swept back wings with negative wing tips have been successfully employed in German machines, and in the Burgess-Dunne, without the use of tail surfaces. Such wings certainly give a great degree both of longitudinal and lateral stability, but at some sacrifice of efficiency. Experimental results, except for complete aeroplane models, are not available, but a simple theoretical discussion at this stage is instructive, this involves the application of the first principles of mechanics, yet always presented considerable difficulty. It also gives us the opportunity of considering the stabilizing influence of tail surfaces in an elementary manner.

Consider the two arrangements of Fig. 11, A and B one with a positive tail surface, the other with a negative tail surface. We will assume the forces on the wing and on the tail

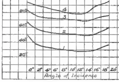


FIG. 10. MOVEMENT OF CENTER OF PRESSURE FOR WINGS WITH VARYING DEGREES OF SWEEP BACK

to be vertical for simplicity's sake although this would not actually be the case, with positions of forces and centre of gravity as in sketch. Assume the force on the wing to be 10 times that on the tail. Then in case A moments about centre of gravity are:

$(10\times1)+(25\times1)=35$ in a diving or counter clockwise direction. The resultant must be aft of the centre of gravity, and since its value is $10+1$, it is $\frac{35}{11} = 3.36$ feet aft

of the centre of gravity between the two forces on wing and tail.

For case B moments about centre of gravity are:

$(10\times1)-(25\times1)=-15$ in a stalling or clockwise direction. The resultant will now be $\frac{15}{9} = 1.67$ feet forward of the centre of gravity and forward of the force on the wing.

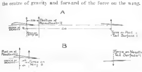


FIG. 11. DIAGRAM TO ILLUSTRATE VARIATION OF RESULTANT FORCE WITH POSITIVE AND NEGATIVE TAIL SURFACES

A negative tail can thus convert a diving moment into a stalling moment at small angles. At large angles of incidence the negative lifting surfaces will become positive and may be used to convert a stalling moment into a diving moment. A negative tail surface can thus be suitably adjusted to give longitudinal stability at all angles within the flight range.

Similarly for a machine with swept back wings and negative wing tips, as shown in Fig. 12, at an angle of 1 degree incidence for a positive section A-A, the force has a counter clockwise moment about the centre of gravity tending to dive the machine. For a negative section B-B, the force has a stalling moment about the centre of gravity which prevents diving action. Similarly, at large angles of incidence the positive surfaces of the wing may tend to stall the machine, while the negative wing tips then assume a positive action and counteract the tendency to stall. Thus if the wings are sufficiently swept back and the negative surfaces powerful, static longitudinal stability can be secured.

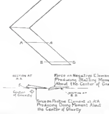


FIG. 12. DIAGRAM TO ILLUSTRATE STABILIZING EFFECT OF SWEPT BACK WINGS WITH NEGATIVE WING TIPS

The negative surfaces having so small an arm compared with negative tail surface must have a much larger surface than the latter. Consequently such an arrangement must be aerodynamically inefficient. This may be compensated for by the fact that no structural extensions to tail surfaces are necessary in a machine of this type.

Reference for Section 6

EFFECT OF VARIATION OF POSITION OF MAXIMUM ORDINATE IN A WING SECTION OF PLANE LOWER SURFACE AND CONSTANT CAMBER FOR UPPER SURFACE

British Report 1912-1913. No. 72. Section (1).

BEHAVIOR OF WINGS WITH REVERSE CURVATURE AT THE TRAILING EDGE

British Report 1912-1913, page 85.

Supplement to Eiffel's Resistance of Air and Aviation, page 151.

Nouvelles Recherches sur la Resistance de l'Air et l'Aviation. Eiffel, page 114.

EFFECTS OF THICKENING THE LEADING EDGE OF A WING

British Report 1912-1913. No. 72 page 75.

EFFECT OF PHILLIPS ENTRY

Loc. Cit., page 76.

EFFECTS OF THICKENING TOWARDS THE TRAILING EDGE

Loc. Cit., page 77.

EFFECTS OF VARYING ASPECT RATIO

O. Föppl, *Zeitschrift für Flugtechnik* April 30 1910.

O. Föppl, *Zeitschrift für Flugtechnik* August 13, 1910.

British Report 1911-1912. No. 62 page 74.

Eiffel (Hunsaker). The Resistance of Air and Aviation, page 143-148.

Eiffel. Nouvelles Recherches sur la Resistance de l'Air et l'Aviation, page 136.

EXPERIMENTS ON "RAKING" THE PLAN FORM OF A WING

Nouvelles Recherches sur la Resistance de l'Air et l'Aviation. Eiffel, page 141.

Mitteilungen aus der Göttinger Modelversuchsanstalt. Sonderabdruck, *Zeitschrift für Flugtechnik* 1910 Heft 20, 1911, Heft 7, 13, 14.

SWEPT BACK WINGS

H. E. Rossell and C. L. Brand.

Wind Tunnel Experiments in Aerodynamics. Smithsonian Miscellaneous Collections. Vol. 62 No. 4.

Section 7 of the course will be devoted to the study of pressure distribution on wing sections, a short section of immediate application, but one which helps to explain the various phenomena we have hitherto considered.

Sections 8 and 9 will deal with the very important and practical problems of biplane combinations, and calculation of fixed horizontal surfaces necessary for longitudinal stability.

Aeronautical Patents

Copies of these patents may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

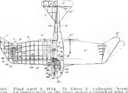
ISSUED SEPTEMBER 26 1916

1,119,215. Filed Dec. 1 1915. To Sidney W. Smith, Berkeley, Cal. A combination of biplane forward and monoplane rear, with triple propellers.

1,199,629. Filed Oct. 1, 1915. To Clarence La Fayette Stocks, Blue Ridge, Ga. A protective helmet for aviators.

ISSUED OCTOBER 3 1916.

1,200,097. Filed July 23, 1913. To Edson F. Gallaudet, Norwich, Conn. An interesting patent on aeroplane wing construction. The wings are flexible at their outer ends and provided with movable tips whereby both their surface or superficial area and fore and aft center of pressure can be changed. The tips of the wings can be extended or withdrawn simultaneously or singly. The wings are so constructed that variations in air pressure upon the wing on either side of the machine can be minimized by flexing, and are so mounted that they may rock about a transverse spar thereby changing the angle of incidence.



1,200,098. Filed April 4, 1914. To Edson F. Gallaudet, Norwich, Conn. An improvement on the above patent's extending wing tips.

1,200,251. Filed Nov. 27 1915. To Albert Herbert Smith, Great Falls, Mont. A flying machine with a vertical mast supporting a main plane and an auxiliary plane. The main plane is also connected to a longitudinal mast, which extends in front of and the full length of the machine.

1,200,259. Filed July 29 1915. To Joseph A. Steinmetz, Philadelphia, Pa. A false bottom protective device for flying boats. The device is pivoted so as to be adjustable and extends about one third the length of the hull.

1,200,288. Filed Oct. 31, 1908. To Erastus L. Winkley, Lynn, Mass. An aeroplane provided with an automatic steering apparatus to restore the machine to a given course as well as an automatic stabilizing mechanism.

National Advisory Committee Discusses Aeronautic Motors

At a public session of the Executive Committee of the National Advisory Committee for Aeronautics, whose minutes were issued last week, the chairman, Brigadier General George P Scriven, U. S. A., called upon Henry Souther and others for statements in regard to American aeronautic motors. Mr. Souther said

"During the last month since I have been on duty with the Signal Corps in connection with aviation motors I have learned a great deal. To put it briefly, I am very much encouraged by what I have learned. It seems to me that any statement made that we are entirely ignorant or hopeless, in the matter of motors for aviation is entirely wrong. If we look back on the early endeavors with motor cars, say in 1900 I see things that make the present aviation motor, in this country, look very good. That motors 100 per cent efficient exist in this country today for aviation purposes, no one will claim. There is no doubt about that. But I do think we are in a fair way to obtain a satisfactory motor and within a reasonable length of time."

Several improvements were suggested in aeronautical motor practice by several of the gentlemen present at the meeting, and for the purpose of helping manufacturers AVIATION AND AERONAUTICAL ENGINEERING presents a symposium of these specific suggestions and complaints under their proper headings. This is in line with the statement by Dr S W Stratton:

"* * * the members of the committee thought we would progress more rapidly if we made a definite, concise statement to the builders of these things as to what was necessary, and on the other hand we would feel better if we had a direct statement from the manufacturers as to what they could and could not do. No very rapid progress can be made until the users and the manufacturers get together. That is not only true of motors, but of many other things * * *"

INCENTIVE

The manufacturers were almost unanimous in blaming the slow steps of American motor development upon the lack of government cooperation and incentive which existed hitherto. Mr Crane said:

"The successful aeroplane motor will be developed and not invented. I think the results to date have more than proved that. As to the reasons why it has not been developed there has been no real incentive in this country to develop a military aviation motor, that is, one which will be reliable over a long stretch of time and can be flown with a minimum weight"

Mr. Coffin agreed, saying:

"This whole aviation development from what I know of it, appears to me to be an experimental proposition from start. There has been practically no real quantity commercial production in that line. We have been trying to build motors which are so near the ragged edge in strength of parts, in durability, lightness, and so forth, that we have gotten into a lot of trouble that we ought to be able to avoid."

Charles M Manly of the Curtiss Aeroplane and Motor Corporation was another who blamed America's slow progress on lack of stimulus. He said

"We began five years ago but we did not have the stimulus. The stimulus has been provided to a certain extent by the present war in Europe. But, unless we are going to be able to keep on having enough business to keep the mill grinding the development is not going to be constant and steady."

G H Abel of the Thomas Brothers Aeroplane Company had met with the same difficulty, as appears from the following statement

"All the men I have been associated with have had one cry and that is the lack of interest and cooperation. But from this meeting it is very noticeable that there is a change of front coming about. With this new feeling on the part of everyone here that we are going forward on a better basis than we have gone thus far, we feel that we can make much greater strides. We have always been hampered by lack of cooperation."

Col. Squier, in charge of Aviation Section of the Signal Corps, U. S. A., made the following remarks telling how government stimulus attempted to develop aeroplane motors abroad:

"I know something about the motor difficulties abroad where they have solved, or have attempted to solve their difficulties by an authorized national engine competition to give a ten thousand pounds prize. The Navy and Army joined in this and asked the manufacturers to compete for the prize. I got possession of a report on that test. It is a confidential report. It gives the qualities and strength of materials, methods of testing, and the whole thing. It is a very serious matter and we could hold a competition. That competition brought out the Green engine. It put England in a position to produce aeroplane engines. Two or three years ago she had to get her engines from France. When she discovered that, she developed the Green engine of her own in this way."

But Mr. Manly of the Curtiss Company showed that while this prize competition might have helped English aeronautics generally, the winners of the competition were benefited only to a limited extent. He said

"Mention was made a little earlier today of the fact that England had conducted some contests and through these contests had evolved the Green engine; and that that possibly might be a good thing in this country. The rather interesting thing about the Green engine is—and that is a thing I was trying to see if we could not avoid over here—the Green engine was put through the most drastic tests that I suppose any engine was ever put through. In fact, the manufacturers were nearly broke when they got through, and when the war came along I understand the Green people got no order for motors. In other words the Army had progressed beyond the Green engine when it came time to buy in quantity."

DELIVERY

Captain Bristol said

"The trouble we have had in the Navy in regard to the development of aeronautics has been principally the lack of a suitable motor. That has been our great trouble and we could not go ahead as we might have done in the development of a naval aeroplane if we could have gotten a motor.

"What we want, gentlemen, is a motor—design and construction for consideration. We have never specified the lowest price, and we have not taken the lowest price bid. That is what I am strongly urging all the time and if Mr. Coffin and the rest of you engineers can get together and get a motor that is what we want. We just want a motor to go in the air with."

It was interesting that Col. Squier, representing the Army, did not complain of lack of motors. But Captain Bristol found no end of trouble. In the afternoon session he said

"I would like to ask some of you gentlemen present if you would say when it you propose to necessary right now to produce motors. I will say for the Navy that we can tell you right now what power we want, then if you will tell us how soon you can give us the engine that looks to me like getting down to business, and that looks to my point of view like what we want."

He concluded his part of the discussion by saying

"I want to get back to my question here of how to get a motor. I want to keep down to that. We have settled one thing pretty conclusively. We want a motor to run on ordinary gasoline. We want a self starter. As regards the weight of a motor the question was brought up as to what would be counted in the weight of a motor. I would say anything that would be required for the operation of that motor is the weight of it—anything that is essential to its running in the air should be included in the weight of it. It includes motor, water circulating pump, starting gear, radiator, and so forth and going a little further, we want a radio set and something a little else. Some people say drive it with a rotary fan. That will not do. It must be run from a motor or an auxiliary motor. You must have your oil and your gasoline to operate the motor. That must count in the weight, for a radius of action of say, ten hours. It must include all the circulating water, oil, gas and so forth to run it. If you are going to put on some kind of a big propeller, that weight has got to count into it. Then anything peculiar to your motor has got to count into its weight. In other words we want to know the weight of the machinery that is necessary to drive that aeroplane. We can lift so much weight, and when we know how much weight the driving mechanism carries, then we will build a machine around it."

MAGNETOS

Magnetos and the methods employed to run them were discussed and some helpful suggestions made. Mr Souther said in this connection:

"One of the Army fliers came from Mexico recently after much difficult flying. I was keen, indeed, to know from him first-hand what motor troubles he had and I questioned him on the subject. I asked him the direct question as to what predominated in his mind as the most serious motor failure that he had experienced in actual service. He thought it over very carefully, and stated that the dominant failure was the magneto failure. We have all believed that magnetos were about

right. I believe that later developments will show that it was not the magneto itself that was at fault, particularly the electrical or mechanical parts of it, but rather the method by which it was attached to the motor and driven. The magneto was called up to bear shocks by unfortunate mounting or drives that were unnecessary. That is a thing which should be avoided."

Lieutenant W. G. Child told of the Navy air service's magneto trouble. He said:

"* * * we have had of course the same trouble and it has been very serious. We have had to change magnetos very frequently due principally to the shaking apart of the magnetos caused by vibration of the motors. That of course, brings up the question of the balancing of parts, and having similar parts the same weight.

"As we get higher horsepower in motors, it seems to me an advantage to have electric ignition because we have got to have starters. It is probable that the electric ignition will be used because you save in weight by using electricity and you need a hot spark at low speed. I think there are a number of motors developed to a sufficiently high state of reliability that they can be used. If magneto ignition is used, weight is saved by using an air starter."

Howard E Coffin of the Hudson Motor Car Company of New York and the Naval Consulting Board also spoke of magneto trouble. This was his opinion:

"Now, to go back to the magneto trouble that has been mentioned. There is no excuse for magneto failure on an aeroplane engine other things being equal. That is, within the magneto itself there should be no failure in ordinary service such as an aeroplane is put to, because an aeroplane is not used so continuously as a motor truck for instance which is also fired by a magneto. A great deal of trouble develops because the magneto is not properly mounted on the motor. No magneto should carry a gear directly on its shaft. We learned that in racing cars in 1906."

Henry Crane of the Crane-Simplex-Wright-Martin Company, who brought the Hispano-Suiza motor to this country, thought Mr Souther was correct, for he said:

"I think Mr. Souther is absolutely correct on the magneto. One of the great sources of difficulty is the method of driving. The average motor car will run from seven to nine hundred or a thousand revolutions, on a yearly average. The six cylinder magneto will give trouble about every six months, the four cylinder much less."

WIRING

Closely connected with the magneto problem is the wiring problem. It is clear from the discussion that much is left to be desired in the standard practice in wiring aeroplanes. Mr Coffin in talking about wiring said.

"The wiring in the average aeroplane is a joke. All wiring must be carried in metal conduits. I think the wiring of an automobile or the wiring of an aeroplane should pass examination similar to the underwriters examination by the insurance companies. You would not think of building a five-thousand-dollar garage without the underwriters passing on the wiring installation, yet you will spend ten thousand dollars on an aeroplane, and risk your life in it, and not take any precautions as to the wiring."

Mr Coffin's statement was brought out by Mr. Souther's opening remarks in which he said

"In a recent visit to a flying camp I saw some very good illustrations of what not to do. I saw wiring of a careless nature in the planes used. In this state of the art, there is no excuse for such wiring. I am not saying this in harsh criticism but to make the point. Defective wiring is as dangerous as a broken crank shaft."

GASOLINE PIPING

"Danger of accident may come from an accumulation of gasoline in the shape of a puddle somewhere in the structure," Mr Souther continued. "A back fire is not usually dangerous unless there is a volume of gasoline present, to catch on fire and keep on burning. An oil pan full of gasoline will burn up a motor car; a similar condition must be more dangerous in an aeroplane. The character of gasoline piping is therefore just as important as anything. It must not vibrate with danger of falling apart. If it does there is a catastrophe. It must not chafe, with resulting leaks."

VIBRATION

The damaging effect of vibration upon aeronautical motors was mentioned and discussed. Mr Coffin gave his verdict for the six and twelve cylinder types, saying

"The six and the twelve-cylinder machines are the only two types of engines which can be in a practical way freed from vibrations as they should be. The six-cylinder motors have not been as free from vibration as they should be but we have made a long step forward this year. My own concern, for instance, has spent a great deal of time on this feature alone.

"It would very much surprise all of you gentlemen in this room if you would take a six-cylinder engine—the nearest thing to a perfect balance in the line of a motor—and drive that engine with an electric motor, so that the engine itself is not run under its own power, at speeds up to two or three thousand revolutions per minute. You would be very much surprised, after you had stripped everything off that engine down to the crank shaft, to find you had practically the same amount of noise left that you had when you started. This leads us to the conclusion that the principal difficulties in the gas engine are tied up in some way with the crank shaft. And it does not make any difference how heavy we make the shaft. Adding weight to it will probably make the troubles worse. Many light shafts behave very much better in a crank-case than a heavy shaft."

Mr. Crane, who is developing an eight cylinder motor, replied:

"As far as the question of vibration is concerned, I would just like to say a word to Mr Coffin on that—I mean in answer to his remarks. In the aviation motor you are building a motor to run at full power at a certain fixed speed. You have got to cover every speed in a motor car, up to two or three thousand or even higher, revolutions per minute. The conditions that a six or twelve-cylinder engine is required to meet in a motor car the eight can meet in an aeroplane. The variations of torque due to irregular firing which are apt to be present in twelve or six-cylinder motors, will show more vibration and cause more damage than the slight vibration of an eight, is simply due to its moving parts, provided the eight is otherwise better. The fewer the cylinders the simpler the job is."

Mr McCulla of the Packard Motor Car Company had this suggestion to offer one of the causes of vibration:

"Several weeks ago I was at a place where there was an aeroplane motor taken down to be overhauled. The pistons arrived ready to be installed, but one piston was not within an ounce and a quarter of any other piston, that is no two pistons were the same weight. In an automobile factory we hold them to equal dimensions. That aeroplane motor was considered a first-class motor but the closest any one of those eight pistons came to another was one and a quarter ounces—and then people expect the magneto to stand up."

RELIABILITY

Mr. Souther introduced the subject of reliability in his opening remarks, saying:

"One of the qualities demanded is stated as being reliability. There can be no argument about that. That quality can be attained not by what may be called freakish methods, or by invention, but by sound engineering. Reliability does not necessarily mean anything unusually strong as a crank-shaft, or an unusually strong motor as a whole. It means reliable wiring, for one thing and all other such details."

Commander Bristol condemned American motor unreliability, and complained that improvements the Navy suggested were not made by the manufacturers:

"As regards unreliability of motors our experience has been," he said, "that nearly everything about the motors has broken at some time or other. It is not any one thing. We have communicated with designers and fliers. In some cases, not in all cases, we found that this magneto problem has not been corrected, and the gas leads that have been broken time and time again have not been corrected."

Lieutenant Child took a brighter view but endorsed his superior's opinions as to past experiences, saying:

"Our experience in the Navy has demonstrated that at some time or other almost every part of the motor has given trouble. I do not think you could name a part of it that has broken at some time or other. But when a break has occurred and the attention of the maker has been called to it, in many cases it has been remedied, so the per cent of casualties now is very much less than it used to be."

TESTING

Charles H. Day, engineer and designer of the Standard Aeroplane Company, gave it as his opinion that motors ought to be tested in planes. He said:

"One thing I would like to make a point of is that too much stress cannot be put on the fact that motors should be tested in the planes. I have found that motors that have run satisfactorily on the stand will not run satisfactorily in the air, and I have also seen the reverse. I think the only true test is to test the machine in the air. I think I could point out half a dozen of both instances from my own experience."

News of the Fortnight

The Attack on the Aviation Section

An indictment of Major William Mitchell, U. S. A., as assistant to the officer in charge of the Aviation Section of the Signal Corps, was presented to Secretary of War Baker last September. Major Mitchell was charged with being an obstructionist of aeronautical progress, with issuing orders without authority, with inefficiency and neglect of duty and with disrespect for the organized militia. The character of the allegations was such that Secretary Baker took charge of their investigation personally, and his report, which has just been published, states "that the allegations have not been substantiated even in the slightest degree."

The crux of the controversy seems to be in the question of the proper expenditure of the large Congressional appropriation, and especially that part of it which is to be devoted to National Guard units.

It seems unfortunate that through some misapprehension the Aero Club of America should have come to loggerheads with the Aviation Section of the Signal Corps.

The Aero Club of America played an important part in securing the $13,281,666 which Congress appropriated. It is their understanding that $9,640,800 should be devoted to the National Guard. The army officers maintain that the appropriation of $13,281,666 came to them practically without restrictions, and that it is their duty to spend it in whatever way seems best to them to build a real American Air Service.

As was pointed out by one of the officers of the Aviation Section in an interview published in the last issue of AVIATION AND AERONAUTICAL ENGINEERING, success with the National Guard depends upon having trained units able to take the field as units as well in aviation as in cavalry, infantry or artillery work. Provision has been made so that any state whose seriously desires an Aero Company can get one. The army men maintain that an Aero Company is unlikely at any time to be of service to a state except in so far as it forms part of the effective fighting forces of the United States.

If the object in building our air fleet is to get fliers for the United States Army who can be of use in case of war, then it is the Federal Government's duty to train those fliers as Federal Reserve officers. Under the language of the bill, the Aviation Section of the Signal Corps has power to train an unlimited number of Reserve Military Aviators with the rank of First Lieutenant, and, as fast as applications are received for training in this grade the applicants will be examined for instruction. Persons wishing to apply should communicate with the Officer in Charge of the Aviation Section, War Department, Washington, D. C.

Navy Abandons Pushers

It is reported that the Pensacola Aeronautic Station has abandoned the use of open type pusher seaplanes for school purposes. A recent order for thirty machines from the Curtiss Company will furnish the station with additional equipment. These are to be of the tractor type biplane.

Chicago-New York, Non-Stop Flight Projected

Victor Carlstrom is making preparations for attempting a flight from Chicago to New York between sunrise and sunset in a Curtiss 160 horsepower VX motored tractor biplane of the R4 type. The *New York Times* is sponsor for the flight, having made arrangements with the Post Office Department for Carlstrom to carry a limited quantity of mail.

CARLSTROM'S INTENDED ROUTE

Carlstrom intends to skirt the lower end of Lake Michigan and then cut straight across country to Cleveland. For the latter half of this part of his trip he will hug the shore line of Lake Erie to guide him, but the best path across Indiana must be made by the compass alone. After Cleveland he will again forsake the line of the lake shore and cut straight across to the neighborhood of Jamestown, N. Y., thence due east a little north of the Pennsylvania line over Elmira and Binghamton. At the latter city he will turn off to the southeast and fly over Port Jervis and Paterson, and then, swinging eastward again, he will come out on the Hudson in the neighborhood of the Fort Lee Ferry, and will fly along Riverside Drive to the finish point of his route, which will probably be Governors Island. The finish of the flight may thus be witnessed by New Yorkers from Riverside Drive and from roofs all over the city.

It is expected that if winds are favorable, the flight will occupy about ten hours. The distance is about 900 miles. Carlstrom expects no trouble from his abandonment of the obvious course of following one of the direct railroad lines.

FUEL THE BIG PROBLEM

"The question of a flight from Chicago to New York without stopping, he said, "is of course chiefly a question of fuel. An immense quantity of gasoline must be carried, and obviously the most direct route, other things being equal, is the best. But by bearing to the north as far as I can go from Jamestown to Binghamton I shall avoid most of the mountainous country which makes the last half of the trip the more difficult part of the problem.

"I expect to fly at an altitude of perhaps 6,000 to 8,000 feet. At this height one of course, has a view over an immense extent of country. If the weather is clear Mr. Carlstrom will be able to see from 80 to 110 miles all around him. Probably I shall not be out of sight of the lakes very long during the first half of the trip. I expect to make the voyage by map and compass, and shall rely on the drift indicator to keep me from being turned out of my course by the wind. In fact, the wind ought to be of considerable assistance. At a height of 6,000 or 8,000 feet it is possible to count on a westerly wind with more confidence than at lower levels."

Glenn H. Curtiss, president of the Curtiss Company, which is arranging the trip for *The Times*, has asked the War Department for the use of the army aviation field at Chicago as a starting point and for Governors Island as a finish.

Sturtevant Clippings

Press reports state that the United States War Department has ordered four combination land-and-water aeroplanes from the Sturtevant Aeroplane Company of Jamaica Plain, Mass. The spars and main ribs are to be constructed of steel. They are to have a wing spread of 71 feet and a capacity of two persons in addition to six hours' fuel and equipment. The power will be furnished by an eight-cylinder, 140-horse-power Sturtevant motor, turning a 10-foot propeller. The design calls for means for a quick interchange from pontoons to wheels.

Two 135 horse-power battleplanes have been shipped from Boston to San Diego by the company. The aeroplanes are the most powerful yet sent and will be used as advanced training machines. It is hoped that the constant and severe work which the machines will be given will give a thorough practical test of the effect of vibration upon aeroplanes built with steel girder construction.

The company is perfecting a monoplane speed scout with about 200 square feet of supporting surface and a 140-horsepower motor, according to A. J. Philpott, of Boston. The machine is stored at the big hangar of the Atlantic Aviation Field, Squantum, Mass., which was used at the time of the aviation meets in 1910 and 1911. Tests have also been made there of the convertible land and water machine designed for the United States Navy.

Authoritative Aeronautic Books

A list of books on aeronautical subjects which the Chief Signal Officer desires to purchase is published herewith. It contains the titles of books which the army approves and which may, therefore, be regarded as authoritative in at least some parts. Together with the First Annual report of the National Advisory Committee for Aeronautics, they make quite a complete aeronautical library. The list follows:

Aircraft in Warfare	Lanchester
Military Aeroplanes	Loening
Aeroplane Design	Barnwell
Aeroplane Design	Horne
Aeroplane in War	Grahame White & Harper
Aircraft in War	Spaight
Flying	Hamel & Turner
The Aeroplane	Grahame White & Harper
Flight Without Formulae	De Bois
All the World's Aircraft	Jane
The Dirt Aeronautics	Hayward
Dynamics of Aeronautics	Turner
Design of Aeroplanes	Judge
Aviation Pocket Book 1916	Matt
Learning to Fly	Grahame White & Harper
How to Build an Aeroplane	Petit
Aero Engines	Burls
Aircraft in War and Peace	Hudson

Dinner to Glenn L. Martin

Upon the occasion of Glenn L. Martin's farewell to California last week, a dinner was given in his honor at the Los Angeles Athletic Club.

Two officers from the United States Aviation Station at North Island, San Diego, Cal., were guests at the banquet. These were Colonel W. A. Glassford, commanding the station, and Lieutenant H. A. Dargue, who flew over from North Island in a Martin seaplane. The 125 miles were covered in one hour and fifty minutes.

Joseph B. Scott acted as toastmaster. After a brief eulogy of Mr. Martin's achievements in the development of aeronautics he proposed his health. In response to the toast, Mr. Martin described the rapid development of flying machines from the rare and crude aeroplanes which would fly about ten minutes to those, which Mr. Martin said, he is turning out at the rate of one every four days, and which will carry 400 pounds of useful load. Mr. Martin "dipped into the future" to announce that he has completed plans for a machine to carry fifteen passengers a distance of 1000 miles at a rate of 100 miles an hour.

Colonel Glassford, Lieutenant Dargue and G. E. Stephenson of the Santa Ana, Cal., *Register* also made addresses.

The New Eaton Hydroaeroplane

A large hydroaeroplane, designed and built by Warren S. Eaton, was launched recently at Classon's Point, N. J. The plane was built for approval by the United States Navy, and designer Eaton purposes to fly it to Washington. On the

Central News Photo Service

WARREN S. EATON'S NEW HYDROAEROPLANE

day of its launching the machine turned turtle on account of the high wind that was blowing. The plane has a top plane of 61 feet spread, and according to her designer, the two 90 horsepower engines that supply the motive power give it a lifting power of 4000 pounds.

Work Is Progressing on the Mt. Clemens Field

The aviation field at Mount Clemens, Mich., planned by the Packard interests of Detroit, is assuming definite shape. A large acreage has been acquired between Mount Clemens and Lake St. Clair, and workmen have been kept busy during the summer removing buildings, trees and fences. The whole field will be plowed and leveled off and laid out with cement roads.

Examinations for Aviation Reserve Corps

According to a Washington, D. C., dispatch, examination of candidates for appointment in the aviation reserve corps shortly will be held in that city, San Diego, Cal., Mineola, N. Y., and Chicago. It is planned to employ a number of officers and enlisted men of the reserve corps on active duty in time of peace as well as in war time, because the authorized strength of the regular army aviation section is inadequate for the formation of the aeroplane and balloon organizations required.

Much interest is being taken in the reserve corps among aviators, and it is expected that a large number of candidates will take the examination.

Chicago Has United States Aviation Station

Capt. J. C. Morrow, Signal Corps, U. S. A., in charge of aviation in the central department, has completed arrangements for the army to use the field of the Aero Club of Illinois for one of its training stations.

"By an arrangement with the Aero Club of Illinois," Captain Morrow said, "the United States will use the club's aviation field at Ashburn, twelve miles from Chicago, for one of its three aviation schools. The other two schools are at San Diego, Cal. and Mineola, Long Island, N. Y. The school at Ashburn will be known as the United States Aviation Station.

"Two Curtiss tractor aeroplanes to be used in instructing students, have been received," continued Captain Morrow, "and two more are expected daily. The students will be enrolled in the reserve corps when proficient."

It is the intention of the Aviation Section of the Signal Corps, U. S. A., to establish more aviation stations as fast as they are needed by applications for enlistment in the Aerial Reserve Corps.

(C) [illegible]

Mr. and Mrs. A. S. Heinrich in the twin-motored tractor biplane which Mr. Heinrich designed and built for the Atlantic Aircraft Company. Mrs. Heinrich is seated in the front seat, behind the "Belgium Rattlesnake," as the Lewis machine gun is called abroad. A bomb is attached underneath the fuselage.

Frequent flights are being made in this machine, which is said to climb very rapidly, to have a very flat, gliding angle, and to land at comparatively low speed.

National Advisory Committee for Aeronautics

The annual meeting of the National Advisory Committee for Aeronautics was held in the offices of the committee on October 5. The following members were present: Prof. W. F. Durand; Captain Mark L. Bristol, U. S. N.; Dr. Charles D. Walcott; Prof. John F. Hayford; Dr. S. W. Stratton; Prof. Charles F. Marvin; Lieut.-Col. Geo. O. Squier, U. S. A.; and Naval Constructor H. C. Richardson, U. S. N. The committee considered the work that had been accomplished during the past year, and inaugurated a program of work for next year.

AN AERIAL MAIL SERVICE

Hon. Otto Praeger, Second Assistant Postmaster-General, attended the meeting and informed the committee of the efforts of the Post Office Department to inaugurate an aerial postal service, and of the difficulties encountered. As a result of this visit it appears that the Advisory Committee can be of considerable assistance in attacking the problem, and subcommittees of the Post Office Department and the National Advisory Committee for Aeronautics will at once proceed to take up the matter.

One of the most important objects accomplished by the committee during the past year has been the development of cooperation, through its Subcommittee on Motive Power, with the Society of Automobile Engineers. This latter society has become sufficiently interested in the subject to appoint a sub-

committee to act with the Advisory Committee in advance of a proposed change in the organization of the Society of Automobile Engineers, which will result in the extension of the work of that society to cover aeronautics.

This proposed reorganization is largely due to the action of the Advisory Committee in inviting the representatives of the principal aeronautic engineer designers to appear at a meeting of the committee held in the Smithsonian Institution on June 8. Already valuable results have been accomplished in the standardization and development of aeronautic engines and accessories, and it is believed that through the lawful co-operation thus inaugurated, a very considerable advance in aeronautic engine construction and design may be looked for during the coming year.

REPORTS TO BE ISSUED

During the past year the committee has obtained a number of valuable reports on various subjects of interest in aeronautics, which reports will be embodied in the annual report of the committee. In order to avoid the delay which would otherwise be involved, due to the necessity of the committee submitting its report to Congress, the several reports will be issued separately by the committee at the earliest practicable date. These reports will cover the following subjects:

Report No. 8.—General Specifications for Aeronautic Instruments.
Report No. 9.—Aeronautical Nomenclature.
Report No. 10.—Gasoline Carburetor Design.
Report No. 11.—Exhaust Muffler for Aeronautic Engines.
Report No. 12.—The Physics of the Air.
Report No. 13.—Experimental Researches on the Resistance of Air.

Report No. 8 has already been published and issued by the committee. Report No. 9 on the subject of aeronautical nomenclature, deals with the terms which are new and peculiar to the science and art of aeronautics, and is intended to eliminate the confusion which has already resulted from the adoption and application of many new terms which have already been evolved in the past few years of the active practice of aeronautics. The committee finds that the interest in aeronautics has grown tremendously during the past year, and is pleased to note that Congress, in its appropriations for the War and Navy Departments, has recognized the value of the new service.

At the annual election of officers, the following were elected to serve for the ensuing year:

Chairman, Prof. W. F. Durand.
Secretary, Naval Constructor H. C. Richardson, U. S. N.
Executive Committee
Dr. Chas. D. Walcott, Capt. M. L. Bristol, U. S. N.
Dr. S. W. Stratton, Prof. Joseph S. Ames.
Prof. M. I. Pupin, Lt. Col. G. O. Squier, U. S. A.
Prof. Chas. F. Marvin, Naval Constructor H. C. Richardson, U. S. N.

Because of the late date of the passage of the appropriation for this year, the committee is just getting under way to carry on the extensive work provided for in the appropriation, and before the end of the fiscal year expects to have this work well in hand.

Requirements for Exhibition and Military Motors

Roy Laird, one of De Lloyd Thompson's pupils, has explained that aeroplane motors for exhibition flying do not have to meet the same requirements as military aeroplane motors. In an interview published in the Grand Junction, Colo., News he said:

"It would be just as much of a joke for exhibition aviators to offer their trick flying aeroplanes to the government as it would be for the owners of thoroughbred race horses to offer them to pull wagon trains over deserts and mountains. They would be useless—yes, worse than useless.

"An biplane motor is good for 15 minutes rapid fire aerial gymnastics, and the motor is tuned to go at top speed for that length of time. The motors we use in our engines in the clouds are tuned always to the concert pitch and would not last an hour in army scouting or other army flying work.

"Just as soon as the government gets enough planes of the right sort for its own aviators, I am confident it will stimulate the interest of the nation's most famous trick fliers in our national defense, and one and all of us will quickly join the reserve corps if they do not belong to the regular service."

Tests of E. S. Draper's Burgess Seaplane

The Burgess Company has made a series of tests of the machine purchased by E. S. Draper. The motor is a Curtiss

OXX-2 100 horsepower. The tests were witnessed and certified by Lieut. ... U. S. N., who was the observing passenger.

Weights		
Machine light		1750 lbs.
Loaded as follows:		
... gallons oil	21	
... gallons gas line	162	
5½ gallons water	44	
2 passengers	340	
Total load	567	567
Total gross weight		2317 lbs.
Average high speed (with and ...)		75.2 m/h
Average low speed (with and ...)		48.3 m/h
Climb as follows: (Average ...)		300 feet
Starting at		750 feet
1st min.		1100 feet
2nd min.		1400 feet
3rd min.		1720 feet
4th min.		2015 feet
5th min.		2345 feet
6th min.		2650 feet
7th min. turning		2920 feet
8th min. turning		3180 feet
9th min.		3440 feet
10th min.		3780 feet

The Condor Aero Company to Build Aeroplanes

A. R. Grant, a director of the Condor Aero Company of Buffalo, has announced that the company would build a plant in which to manufacture aeroplanes at North Tonawanda, N. Y. The company, which was recently incorporated with a capital stock of $5,000,000, will start within 30 days to build flying machines. Max Near and Valentine Beuttner of Buffalo designed the aeroplane that will be manufactured.

These are the officers of the company: President, William J. Hines; vice-presidents, Max Near and Valentine Beuttner; secretary, George A. Cotton; treasurer, William J. Wright. The directors are A. R. Grant, Douglas Beckwith, E. L. Moses and Horace D. Hunt. The site which the company will occupy in the Walck road contains 28 acres.

IT IS REPORTED THAT—

Tests of the wireless telegraph and telephone set invented by Dr. Lee de Forest for application to aeroplanes, as well as of the new aeroplane stabilizer invented by J. W. Macy, are being made at the United States Army Avia-

Photo by Aero News Service

J. W. Macy

tion Station at Mineola, L. I. At one of the recent tests, the stabilizer was fitted to a Martin biplane, and the machine was piloted by Sergeant W. C. Ocker, U. S. A. The test is said to have been successful.

KIFFIN ROCKWELL of Atlanta, Ga., lost his life fighting for France when his aeroplane was shot down in an air duel with a German flier over Alsace, falling within the French lines. Before joining the American flying corps of France he was a resident of Atlanta and was a member of an advertising agency. He was first mentioned in the French dispatches May 21 for bringing down a German aeroplane near Hartmanns-Weilerkopf. His third victim was dropped while he was flying with Bert Hall, an American, and his fourth while he was flying alone over Verdun.

JOHN LORENSCHER of Dubuque, Iowa, is said to be making daily flights, in an aeroplane of his own construction, at the Park Life grounds at Zollecoffer's Lake, near Dubuque. In its first test flight, the machine is said to have attained an altitude of 1800 feet and remained in the air twenty-three minutes.

AVIATOR BROWN is filling engagements at county fairs in New York and neighboring states with his gyromotored 90 horse-power two-seated tractor biplane.

FRED DE KOR, aviator, was fatally injured at Bethany, Mo., when he lost control of his biplane and fell only 100 feet on top of the grandstand at the fair grounds. The tricky currents immediately above the grandstand, together with the bumpy atmospheric conditions, probably caused De Kor, who was an expert looping specialist, to lose control.

LEWIS GERSTON was under contract to appear daily and nightly at the Utah State Fair in Salt Lake City, Utah, from September 30 to October 7.

CAPT. FRANK E. GOODRICH of Hallowell, Me., a member of the British Royal Flying Corps, was killed in action on September 12 somewhere in France.

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YOUNG MAN with good habits, machinist, desires position with reliable aeroplane company to learn aviation and become aviator. Address Box 21.

YOUNG MAN desires position with aeroplane company to learn aviation; understands gas engines, is a mechanic. Address Box 32.

ENERGETIC YOUNG MAN desires position with aeroplane company to learn aviation and know all parts of aeroplanes. Address, Box 24.

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HOW TO UNDERSTAND AEROPLANES, by S. L. Walkden. Fourth edition, enlarged. Contains exclusive matter. 40,000 sold. 125 pages, 88 figures and illustrations. Price $1.00 post paid. W. E. Walkden, 2909 Fifth St., San Diego, Calif.

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